

**UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA**

STATE OF OKLAHOMA, ex. rel. W.A. DREW
EDMONDSON, in his capacity as ATTORNEY
GENERAL OF THE STATE OF OKLAHOMA
and OKLAHOMA SECRETARY OF THE
ENVIRONMENT, J.D. Strong, in his
capacity as the TRUSTEE FOR NATURAL
RESOURCE FOR THE STATE OF
OKLAHOMA

Plaintiffs,

v.

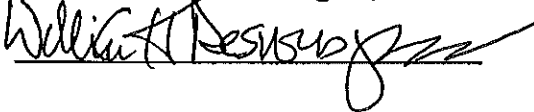
TYSON FOODS, INC., TYSON
POULTRY, INC., TYSON CHICKEN, INC.,
COBB-VANTRESS, INC., AVIAGEN, INC.,
CAL-MAINE FOODS, INC., CAL-MAINE
FARMS, INC., CARGILL, INC., CARGILL
TURKEY PRODUCTION, LLC, GEORGE'S
INC., GEORGE'S FARMS, INC., PETERSON
FARMS, INC., SIMMONS FOODS INC., and
WILLOW BROOK FOODS, INC.,

Defendants.

Case No. 05-CV-329-GKF-PJC

EXPERT REPORT OF

William H. Desvousges, Ph.D.



Gordon C. Rausser, Ph.D.



March 31, 2009

INTRODUCTION AND SUMMARY OF OPINIONS

This report provides the expert opinions of Dr. William H. Desvousges and Dr. Gordon C. Rausser in response to the plaintiffs' estimate of damages for reducing alleged aesthetic effects and ecosystem injuries from phosphorous in the Illinois River System and Tenkiller Lake to levels that purportedly existed in the 1960s. The plaintiffs in this case hired Stratus Consulting (Stratus) to prepare the damage estimates. Stratus prepared two natural resource damage assessment (NRDA) reports entitled: *Natural Resource Damages Associated with Aesthetic and Ecosystem Injuries to Oklahoma's Illinois River System and Tenkiller Lake*¹ and *Natural Resource Damages Associated with Past Aesthetic and Ecosystem Injuries to Oklahoma's Illinois River System and Tenkiller Lake*.²

The first opinion in this report addresses the recreational use of Tenkiller Lake and the Illinois River. Our analysis is based on several data sources, including data collected, but not used, in the Stratus expert reports. As our analysis below shows, Stratus first conducted a study that interviewed users of Tenkiller Lake and the Illinois River during several months in 2006 (hereafter, user intercept survey). Subsequently, Stratus conducted a telephone survey of a random sample of Oklahoma residents that included both users and people who do not use the resources to gauge their knowledge and awareness of water quality issues in both the Illinois River System and Tenkiller Lake (hereafter, telephone survey). Thus, Stratus could have conducted a damage assessment based on people's actual recreation decisions and determined whether those decisions were affected by water quality. Instead, they chose to rely solely on the hypothetical CV survey, in part because people's perceptions of water quality for the Illinois River System and Tenkiller Lake, based on both the intercept and telephone surveys, were more favorable than the plaintiffs' experts would have preferred.

As part of our investigation, we collected data on recreational uses over time in the Illinois River System and Tenkiller Lake from public data sources. Our analysis shows that the recreation use data from both Stratus and public sources indicate that

¹ The authors of this report include: David J. Chapman, Richard C. Bishop, W. Michael Hanemann, Barbara J. Kanninen, Jon A. Krosnick, Edward R. Morey, and Roger Tourangeau.

² The authors of this report include: W. Michael Hanemann, David J. Chapman, and Richard C. Bishop.

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the Illinois River and Tenkiller Lake are valuable recreation resources and that users find them to be clean and enjoyable. Thus, there has been no lost benefit to the public as a result of an alleged injury to water quality. Consequently, there are no natural resource damages from reduced recreational use. Details supporting this opinion appear in Section 2 of this report.

To further investigate whether alleged injuries to water quality in Tenkiller Lake has impacted residents of the area, we collected and analyzed data on property transactions for single family residences near the lake during an fourteen year period, from 1995 to 2008. Our analysis compares transaction prices for this period to those for neighboring properties. We find no evidence that alleged water quality injuries have reduced property values near Tenkiller Lake. For an additional benchmark, we compared data on sales transactions near portions of Lake Eufaula over the same period of time. Again, we find no evidence that the alleged injuries have affected sales prices of properties near Tenkiller Lake. Section 3 of this report provides the details supporting these opinions.

Additionally, we offer opinions that directly respond to the plaintiffs' estimates of past and future damages that purportedly reflect society's total values for the natural resources at issue. Total values embody both the value that people place on these resources based on their direct experience using the resources (use values) and values that are independent of their use of the resource (nonuse values).

The plaintiffs' estimate of future damages depends solely on the use of the contingent valuation (CV) methodology and fails to include any of the data from the first two Stratus surveys discussed above, or any other public sources. Based on our evaluation, the Stratus damages studies do not conform to the 43 CFR Part 11, the U.S. Department of the Interior natural resource damage assessment regulations. The report was not preceded by a preassessment screen or an assessment plan. Additionally, the report was not available for public review and comment before submittal to the court. Moreover, as we discuss in detail below, the Stratus CV study and the past damages benefits transfer do not meet the requisite reliability conditions that are required to comply with the 43 CFR Part 11 regulations.

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Two features of the plaintiffs' CV methodology are especially critical in regards to evaluating its validity. First, the CV methodology is based on respondents' answers to a hypothetical survey questionnaire. Second, CV cannot reliably measure nonuse values, a component of total values. Because no behavior can be observed with respect to nonuse values, they cannot be directly measured or validated by using objective criteria. The inclusion of nonuse values in the plaintiffs' damages estimates means that it is not possible to externally validate the respondents' answers. Concerns about CV's ability to reliably measure nonuse values prompted the National Oceanic and Atmospheric Administration (NOAA) to form a Blue Ribbon Panel to consider this question. This panel produced a set of guidelines for conducting CV studies (Arrow, et al. 1993)³, which are discussed in detail in Section 3, 4, and 5 of this report. These guidelines comprise the only set of detailed guidance for conducting CV studies. As such, they apply to damage assessments conducted under both the NOAA regulations (15CFR990) and the Department of Interior (43 CFR Part 11) regulations.

The evaluation of validity involves a careful review of the Stratus CV survey questionnaire as it relates to the accuracy, balance, and other factors that may lead to potential biases in the survey respondents' answers. Additionally, the evaluation requires a careful examination of the consistency of the respondents' answers with basic economic principles and resulting validity tests that have evolved in the peer-reviewed literature.

The results of this validity assessment of the Stratus CV methodology are directly relevant to the estimate of past damages, which relies on the CV estimates as a starting point to measure past damages. Specifically, the Stratus report purportedly relies on a methodology known as benefits transfer, in which the results of one study are used to estimate the benefits for another resource. In the novel Stratus application of benefits transfer, the current damage estimate for the Illinois River System and Tenkiller Lake are "transferred" to estimate the past damages. In the Stratus report, past damages are estimated by assuming that the current CV estimates can be extrapolated into the past using some simplistic assumptions about the relationship

³ Arrow, K., R. Solow, P.R. Portnoy, E.E. Leamer, R. Radner, and H. Schuman. 1993. "Report of the NOAA Panel on Contingent Valuation." 58 *Fed. Reg.* 4601 *et. seq.* January 15.

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between current and past injuries to water quality in the Illinois River System and Tenkiller Lake. These past damages are then augmented by adding compound interest.

Based on our review of the Stratus reports and the CV study contained therein, we have concluded that it is an unreliable basis for measuring the potential aesthetic and ecosystem damages to the Illinois River System and Tenkiller Lake from increased phosphorous loads. The CV methodology as applied in this case contains substantial biases all of which render it unreliable for estimating potential damages. Specifically, we conclude that:

- The Stratus survey questionnaire contains biased, misleading and factually incorrect information. Thus, the Stratus questionnaire fails to meet the NOAA panel guidelines for a neutral, balanced presentation of information.
- Many respondents were expressing values for resources different than those intended by the survey designers. Our analysis shows that approximately 80 percent of respondents rejected at least one key feature of the CV survey. In fact, more than 40 percent of respondents indicated that they thought the hypothetical restoration program would benefit other lakes and rivers in Oklahoma. This result, which is often found in CV surveys like the one conducted by the plaintiffs, renders their answers meaningless as a basis for valuing changes in water quality in the Illinois River System and Tenkiller Lake.
- The Stratus survey contains substantial amounts of hypothetical bias (the difference between what people actually do and what they say they would do), a phenomenon that has been demonstrated repeatedly in the literature on CV. In fact, more than 30 percent of respondents in the Stratus statistical analysis paid no state income tax, which was the method in which the hypothetical payments were expressed. Such bias invalidates the CV results as a basis for measuring damages.
- The format used in the Stratus CV survey, in which people express votes on a hypothetical restoration project in a simulated referendum, does not mitigate the hypothetical bias in the survey. We demonstrate substantial differences between a real referendum and the contrived one described in the Stratus report.
- The Stratus report fails in its attempts to correct for hypothetical bias.
- The Stratus damage estimates do not correspond to basic economic principles of demand. Specifically, the Stratus valuation responses do not conform to the law of demand or to fundamental principles related to the responsiveness to income.

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- The scope test devised by Stratus, which measures whether respondents' answers are sensitive to changes in the extent of the injury, contains a fatal flaw that prevents it from serving as a test of potential validity. Their test confounds the amount of injury with the effectiveness of the purported restoration project. Moreover, the outcome of the scope test is largely an artifact of the large sample size the analysts chose for the base survey version.
- The Stratus survey contains nonresponse bias, which results from unknown differences between survey respondents and the people who failed to respond to the survey. Given that the Stratus survey was unable to reach at least 45 percent of potential respondents, this bias is significant. The plaintiffs' attempts to adjust for this bias are ineffective.
- The Stratus damage estimates include an unsubstantiated and flawed assumption that most households in Oklahoma would have the same value for aesthetic and ecosystem changes that were estimated in the CV survey. Our analysis shows that Stratus knows nothing about the awareness and knowledge of respondents that they did not interview, which is a critical requirement for estimating damages for a population as a whole.
- Empirical analysis of the CV results demonstrates the consistently upward bias of the Stratus analytical techniques. In other words, the CV results consistently lead to overstated estimates of damages. The empirical analysis demonstrates that the damage estimates are highly dependent on the analysts' choice of the hypothetical bids.
- The Stratus survey does not conform to all of the NOAA panel guidelines.
- Because plaintiffs' past damages depend critically on the CV study, the plaintiffs' estimate of past damages reflects all of the flaws in the CV study, which render the estimate of past damages unreliable.
- Moreover, the benefits transfer performed by Stratus does not conform to established principles and practices for conducting transfers.

The remainder of this report discusses these opinions in greater detail. Specifically, Section 2 describes the recreation surveys and related data that form the basis of our opinion about recreation uses. Section 3 provides an analysis of real estate property values on and surrounding Tenkiller Lake. Section 4 provides our analysis of the CV survey report and data and the rationales underlying our opinions. Section 5 presents our critique of the novel benefits transfer that Stratus used to estimate past damages. Section 6 describes the aggregation of future damages, while Section 7 describes our evaluation of the plaintiffs' total damages calculations.

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2. RECREATION USE ANALYSIS

To evaluate potential recreation losses from increased phosphorous loadings into the Illinois River System and Tenkiller Lake, we have evaluated information based on people's actual use of their resource, and their unaided perceptions of the quality of those resources. As indicated above, we rely on the results of the Stratus user intercept and telephone survey to form our opinions about whether recreation use has been impacted by phosphorous loadings. We also rely on data from the United States Army Corps of Engineers (COE), which manages Tenkiller Lake and maintains data on recreational uses on that lake, as well as other lakes that the COE manages in Oklahoma and other states. The results of the Stratus user intercept and telephone surveys and the analysis of the COE data indicate that recreational use is increasing in the Illinois River System and Tenkiller Lake and that few residents perceive any reduction in quality of the resources and have experienced no loss in benefits from the resources. Moreover, respondents who had negative impressions of the resources more frequently mentioned other issues such as trash and unruly users. The data and interpretations are discussed below.

2.1 The Stratus user intercept survey shows users experienced high quality recreation in both the Illinois River and Tenkiller Lake.

The primary purpose of the Stratus Illinois River and Tenkiller Lake user intercept survey was to obtain current estimates of recreational use on Tenkiller Lake and the Illinois River (Stratus 2008, p. B-1). The study took place from Memorial Day weekend, 2006 to September 17, 2006. Based on the counts of cars, the number of people in the cars, length of stay, and the total number of times each of these sampling units could have been observed, the total estimated user days over the time period is 294,243 (Stratus 2008).

As part of the survey, Stratus interviewers intercepted recreators and collected information about their behavior and attitudes. Three hundred and ninety-five individuals (90 percent of those intercepted) agreed to participate in the survey. Respondents were asked: "Thinking specifically about the Illinois River/Tenkiller Lake, are there one or two things that you particularly like or dislike about recreation here?"

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Seventy-eight percent of the responses were positive, and only 22 percent were negative. As shown below, negative responses range from congestion at facilities, to trash, to inadequate restroom facilities. Only three respondents, or less than one percent, mention any water quality problems related to increased algae from phosphorous.

Of all the respondents, 272 were intercepted at Tenkiller Lake and asked several questions about the quality of their experiences. When asked what they particularly liked and disliked about recreation there, 422 positive responses and 68 negative responses were given. Thirty-four percent of the respondents explicitly mentioned good water quality as something they specifically liked about Tenkiller Lake. Good water quality was second in frequency of response only to “the natural beauty and aesthetics” of the lake as a quality they particularly liked about recreation at Tenkiller Lake (45 percent).

In contrast, the most common dislike about recreation at Tenkiller Lake was trash and debris at the site (8 percent). The second most common dislike was the limited access and facilities (6 percent). And, the third most common was unruly users of the site (5 percent). Only eight, or about 3 percent, of respondents mentioned poor water quality, and when probed, none mentioned water clarity and three mentioned something related to chicken farms. Of these three, one specifically mentioned that good water quality was something they specifically liked about the lake.

Stratus intercepted 123 respondents at sites along the Illinois River. When respondents were asked what they particularly liked or disliked about recreation at the Illinois River, 223 of the responses (73 percent) were positive and 81 of the responses (27 percent) were negative (respondents gave multiple responses). The most common positive response was the convenience of the River, “it is close to home” (50 percent). The three other most common responses referred to the natural beauty of the river (43 percent), accessibility (40 percent), and lack of congestion (26 percent). Ten percent of respondents specifically mentioned good water quality as something they liked about recreation at the Illinois River.

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The most frequently mentioned dislike about the site was the presence of trash and debris (24 percent). The second most common negative remark was that they did not like the limited access or facilities (14 percent). The third most common dislike was unruly users (11 percent). Finally, nine percent of the respondents mentioned congestion as a dislike. A total of six respondents (1.2 percent) mentioned poor water quality as something they disliked. However, when probed, 4 out of the 6 respondents indicated that they were referring to debris in the water not water clarity. Of the other two respondents, one mentioned algae coming from Lake Francis and the other mentioned nonspecific pollution.

The results of a 2006 Stratus user intercept survey, which are reinforced by the results of the telephone survey discussed below, show that users of the resources have a very good impression of the quality of recreation at the site and the beauty of the site. Specifically, users mention very few negative characteristics of the site, and of those, poor water quality is rarely mentioned. In fact, good water quality and scenic beauty seem to be the most commonly noted characteristics of the sites. Therefore, the user intercept survey indicates that recreators have a positive impression of water quality and enjoyed high quality experiences on both Tenkiller Lake and on trips to the Illinois River.⁴ The results of this study, based on actual users during their recreation trips, are in stark contrast to the results of the Stratus CV study, which is based on responses to hypothetical questions, and was conducted only after dosing respondents with biased and misleading information about water quality conditions in the two waterbodies.

⁴ According to one of the consultants hired by the State, "Water clarity does not seem to be a big issue among floaters. More concerned with litter, crowds and cost of floating experience? Do people care about the P loadings? Do they know about them and their affects (*sic*)?"(Breffe 2004).

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2.2 The Stratus telephone survey reinforces the results of the user intercept study that recreational use is not impacted by water quality.

Stratus also conducted a telephone survey in 2006 to identify respondents' knowledge and use of Oklahoma's waterbodies (particularly Tenkiller Lake and the Illinois River), to determine respondents' awareness and perceptions of water quality problems, and to evaluate the impact of media attention on the poultry industry (Stratus 2007). They used a stratified random sample of the entire state of Oklahoma, which over-sampled residents who live closer to the waterbodies. The results include 400 completed surveys.

As stated by Stratus in its report on the telephone survey, "a critical component of this survey is to determine whether respondents know of any water quality problems in Oklahoma and what they perceived to be the causes of these issues" (Stratus 2007, p. 4). Questions 16 and 17 were designed to elicit the respondents' impressions about the sites without prompting them with any suggestion of water quality as an issue (Stratus 2007). Stratus indicates that this approach "allows respondents to state what they remembered without influencing their views by specifically mentioning water quality in the question" (Stratus 2007, p. 4).

2.2.1 The telephone survey respondents have a favorable impression of the Illinois River and Tenkiller Lake.

Questions 16 and 17 state: "What impression do you have of the Illinois River or Tenkiller Lake? Is there anything especially good or bad about it?" Again, in contrast to the Stratus CV study, the responses are open-ended and provide impressions that are not tainted by the interviewer's suggestions or any leading text. Research has shown that responses to survey questions are heavily influenced by the information that the questionnaire/interviewer provides (Payne, Bettman, and Schkade 1999; Bettman, Luce and Payne 1998; Frederick and Fischhoff 1998; and Rea and Parker 2005).

Considering only those respondents who had visited the Illinois River, most of the responses given to question 16 were positive (81 percent). Some of the impressions provided by the respondents are listed below:

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- “I like it because it has clear drinking water and a strong current to canoe on it. I learned to swim there because it held me up.”
- “We need to make sure it stays the way it is – clean and clear and we need to preserve it and we need to promote catch and release.”
- “Spring-fed clear.”
- “That’s my favorite river. Really pretty. It’s a great river – not particularly deep – you can see the fish it’s that clear – big.”
- “Clear and cold – trout fishing – canoeing.”
- “Clear water.”
- “It’s just good water.”
- “Oh it’s a beautiful float river and it’s good for fishing”
- “Fun place for recreation”
- “It’s clean and the people in Arkansas need to keep their chicken litter in Arkansas and out of the river.”
- “Very pretty”
- “I love it very clear it’s my favorite river and we float every year.”
- “The scenery, it’s very nice”
- “Clarity of the water.”
- “Absolutely beautiful”
- “It’s very scenic, very good”
- “Best place I have ever vacationed”
- “It’s good for activities”
- “I know it’s real cold and it’s good for rafting”
- “Good river to go canoeing”
- “It’s beautiful and the water is clear”
- “Its water is clear it’s good for boating”
- “Pretty. Family oriented.”
- “The good is you get to float in it. I don’t know anything bad about it.”
- “I like the scenery it had beautiful water it’s a great place to take a family on a family outing.”

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There were 233 respondents who had not visited the Illinois River. One hundred thirty-one of those gave some impressions of the river. Most of the impressions were positive or were neutral, such as “heard people raft there.” There were 103 of these positive/neutral responses. Twenty-three of these respondents specifically mentioned the beauty of the river and/or the clear, clean water. Of the 28 negative impressions, half mentioned that they had heard there was a problem with poultry litter (6 percent).

Of the respondents that had visited Tenkiller Lake, 100 provided their impression of the lake, in response to Question 17 on the survey. The vast majority of the impressions were good (92 percent). Most of the impressions referred to the scenic beauty, clear water and recreation opportunities. Some of the impressions given by respondents that describe the beauty and clarity of the water are listed below:

- “It was a pretty, nice lake”
- “Just the beauty of the water”
- “I love it. I’ve got land on Tenkiller”
- “Just pretty water”
- “Like the trees...the rocks and its clean...it has the clear water”
- “It’s pretty”
- “It has nice clear water”
- “Cleanest lake in Oklahoma”
- “It’s a beautiful place”
- “It has clear water – clearer than the others”
- “It’s beautiful –deep and cold”
- “Was the one you can see your feet in the water, it is really clear and you can see fish”
- “Beautiful a lot of people go there”
- “Just know that it’s clearer than most”
- “It’s clear and it’s beautiful”
- “Clear water – the Illinois River runs into the Tenkiller”

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- “I like to go there and boat, it’s so pretty”
- “The water is clear it’s beautiful and it’s not over-crowded”
- “Prettiest lake in Oklahoma. Everything is good about Tenkiller”
- “It’s pretty and blue, not dirty”
- “The only thing I remember it it’s a clear lake, they SCUBA dive down there”
- “Clear water and scenic. Nice facilities. Great fishing.”
- “Pretty lake – cold, deep water”
- “The water is very clear and it has beautiful cliffs ...”
- “Its scenic and the water is very clear and very deep”
- “It’s really clear and really cool to SCUBA dive...”
- “It’s very scenic nice water”
- “Nicest lake in the state”
- “It was very scenic and water very clear”
- “It’s very deep and clear – with the drought water stayed up- good for SCUBA”
- “Nice to dive in – SCUBA diving in the clear water”
- “Great lake with beautiful blue water”
- “It’s a beautiful lake”
- “The cleanliness and the way it is laid out are great”
- “Camp site is nice and the water is good”
- “...one of the cleanest lakes in the state right now”
- “I thought it was very clear”
- “Lake is great – water is clear..”
- “Supposed to have real clear water”
- “Beautiful, I don’t know anything bad about it”
- “Real pretty – clean”

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There were only eight negative impressions given as responses to Question 17 by visitors of Tenkiller Lake. Of those eight, there were three respondents who mentioned diminishing clarity and one that mentioned poultry litter.

There were 207 responses to Question 17 by respondents who had not visited Tenkiller Lake. Only 88 of these respondents had an impression of the lake. Positive impressions were by far the most common, representing 95 percent of the total, or 84 responses. There were four negative impressions given of the lake. One of these responses referred to pollution and one to reduced water clarity.

The responses to Questions 16 and 17 indicate that, without prompting the respondents about water quality being an issue, users' impressions were very positive. The overall impression of the Illinois River is that it is a great recreation area and very scenic. Tenkiller Lake is described by multiple respondents as the most beautiful lake in Oklahoma. The dominant feature of the lake, in the minds of the respondents, seems to be its clear water. There is no indication that recreational users of the Illinois River and Tenkiller Lake are experiencing any lost benefits in the use of these resources as a result of a reduction in water quality or other alleged ecosystem impacts. Even nonusers seemed unaware of any water quality issues associated with the Illinois River and Tenkiller Lake. The very low level of awareness about "poultry litter" was usually described as something they "heard about."

2.2.2 Prompting biases people's impressions of the sites.

After eliciting uncorrupted impressions about the site, the respondents were prompted to respond to the question, "Have you heard of any issue or concerns relating to the Illinois River or Tenkiller Lake or are you unaware of any issues or concerns there?" Forty percent respond that they have heard of issues or concerns, even though less than 20 percent of respondents overall had mentioned any negative impressions of the Illinois River and Tenkiller Lake before being prompted. When asked to describe the issue or concern, Q19, 41 percent of those that were aware of a problem mentioned poultry, whereas before being prompted less than three percent mentioned poultry. These results indicate that even respondents who were aware of the alleged poultry

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litter problem did not consider it significant enough to mention as one of their impressions of the lake or river.

Next, the interviewers probed the respondents that did not mention water quality issues as a concern of which they were aware, by asking them specifically if they were aware of, or had heard of, water quality problems on Tenkiller Lake or the Illinois River. As a result of this explicit prompting, 79 respondents who were not aware of problems before became aware of water quality problems when prompted. Again, this result provides evidence that prompting a respondent can produce different results. A respondent does not want to appear unknowledgeable to an interviewer and will often agree with the interviewer when prompted to do so. The results of the survey then exhibit a bias in the statement of opinion. This phenomenon is well-established in the survey literature (Leggett, et al. 2003; Tourangeau, Rips, and Rasinski 2000).⁵

In summary, the Stratus telephone survey provides similar results to the user intercept survey. Respondents have favorable impressions of both the Illinois River and Tenkiller Lake, with good water quality being one of the desirable features mentioned most often. The Stratus telephone survey is important because it is based on a statewide survey of Oklahoma residents who were not dosed with biased information about water quality.

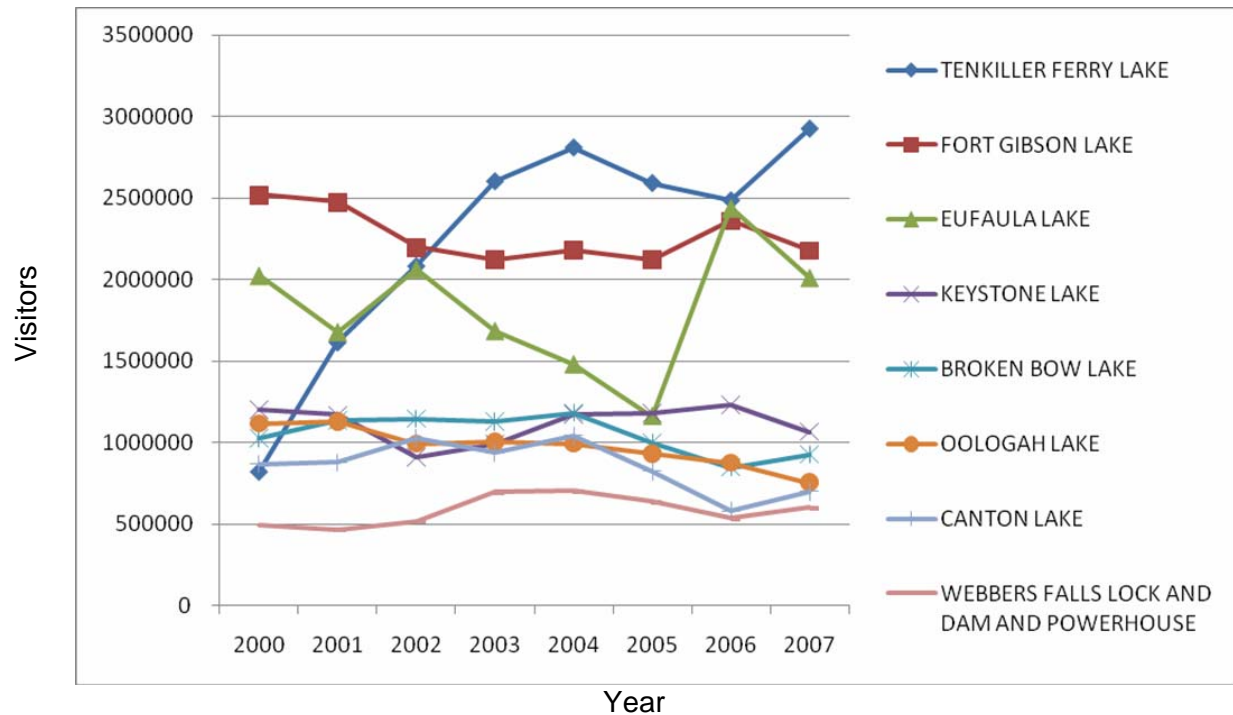
2.3 Data on user fees and from the COE show that Tenkiller Lake and the Illinois River are vibrant recreation resources.

Tenkiller Lake is a recreation site managed by the COE. There are more than 400 COE sites nationally, 28 in Oklahoma. The COE maintains a visitation record for all of its recreation sites. In 2007, Tenkiller Lake was the most visited COE lake in Oklahoma and in the top 10 percent nationally. The trend in visitation for the top eight most visited COE sites in Oklahoma has been fairly stable with exception of Tenkiller Lake. Tenkiller Lake has seen a rise in visitation from 818,522 in 2000 to 2,924,047 in 2007, nearly a 300 percent increase. The remaining top eight sites have seen either a decrease in visitation or have remained unchanged since 2000 (Figure 2.1).

⁵ It also is endemic to the Stratus CV survey, which is discussed in Section 4.1 below.

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Figure 2.1: Number of visitors to the eight most popular U.S. Corps of Engineers lakes in Oklahoma, 2000-2007



In addition, Tenkiller Lake is a popular site for bass tournaments. Annual tournament results showed that Tenkiller Lake consistently was ranked in top 20 lakes included in the results (ODWC 2001; ODWC 2002a; ODWC 2003; ODWC 2004; ODWC 2007).⁶ Field and Stream Magazine (2008) recently cited Tahlequah as one of best fishing towns in America. As part of the rationale for the selection, the magazine praises the largemouth bass fishing in Tenkiller Lake. Specifically, the magazine notes that:

Lake Tenkiller is a gem. Its waters are remarkably clear, and its 130 mile shoreline is picturesque (p.1-2).

Similar statements can be found in the 2009 Lake Tenkiller Visitors Guide:

⁶ In 2000, Tenkiller Lake experienced the only documented fish kill resulting from Largemouth Bass Virus in Oklahoma. Electrofishing catch rates of bass in 2002 showed the lowest numbers since 1990 (ODWCb 2002). The Largemouth Bass Virus may have affected the outcome of Bass Fishing Tournaments for several years following the fish kill.

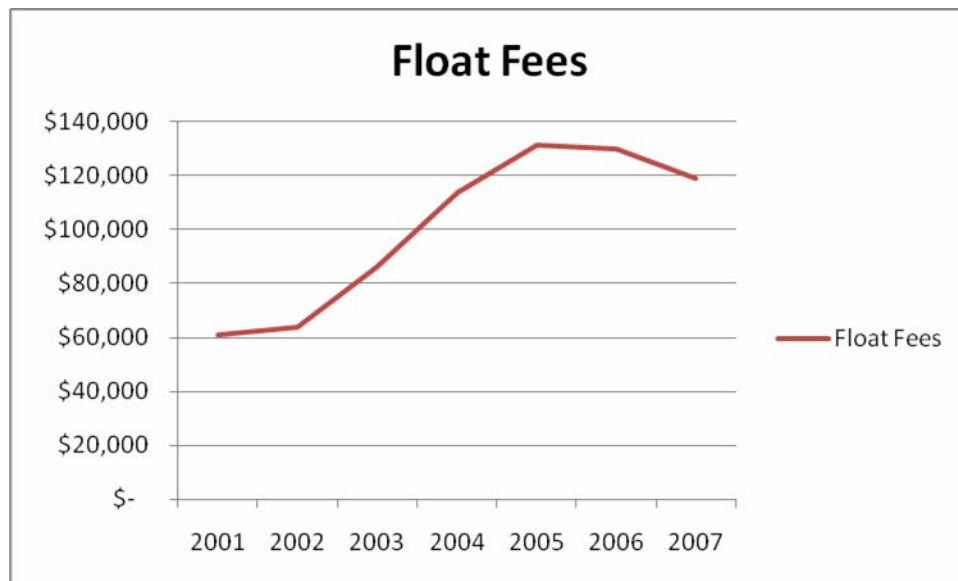
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On the main body of the lake visitors can experience the best water clarity in the State. Each year, countless scuba enthusiasts travel to Tenkiller to dive in its deep clear waters (p.5).

The Visitors Guide characterizes Tenkiller Lake as the Emerald jewel in Oklahoma's Crown of Lakes (Greater Tenkiller Area Association 2009).

Similarly, the Illinois River is a vibrant recreation resource that shows trends of increasing use. For example, the state collects a fee of \$1 per person to float the Illinois River. Use of the river can be tracked through the collection of these fees. As indicated by the yearly fees collected (Figure 2.2), use of the Illinois River by rafters increased steadily from 2002 to 2005 when total user fees collected peaked at more than \$130,000. Total fees collected dropped slightly in 2007, but still remained at around \$120,000.

Figure 2.2: Revenues from Float Fees on the Illinois River



The COE visitation results and the float fee revenues indicate that there has not been a reduction in visitation to Tenkiller Lake or the Illinois River as the result of any alleged injury. In fact, Tenkiller Lake visitation has increased substantially during the past several years. These visitation records support our opinion that recreation users

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have not experienced a reduction in the quality or quantity of their recreation experiences over the past eight years. Moreover, these results are reinforced by those in both the Stratus user intercept survey and the telephone survey of Oklahoma residents, as well as supplemental information on fishing including a national publication touting fishing on Tenkiller Lake. Thus, there is no basis to estimate potential damages related to changes in water quality for Tenkiller Lake and the Illinois River.

In order to understand the factors that affect visitation to COE lakes in Oklahoma, we developed a regression model using lake characteristics. Characteristics describing water quality, facilities, lake characteristics, and distance from population centers are used to explain the level of visitation. Specifically, we use the 22 COE lakes in Oklahoma that have data on lake levels. Measurements of water clarity were obtained from the Oklahoma Water Resources Board. Lake characteristic data were obtained from the COE Tulsa district website. Visitation data were provided by the COE Institute for Water Resources for the years 2000 to 2007.

Our analysis considered a variety of lake characteristics, including the water level in the lake. In particular, water levels deviating from normal would likely affect recreation. In addition, the size of the lake could affect recreation and aesthetics, which would impact visitation. To reflect lake size in the model, we include variables describing the ratio of shoreline to lake acres and lake depth. Facilities available at the site would impact recreation. Therefore, we include variables identifying the number of campsites, boat ramps, and a qualitative variable indicating that the lake had at least one state park. All the facilities data were available on the COE Tulsa district website and the Oklahoma Tourism website.⁷

⁷ <http://www.swt.usace.army.mil/>; <http://www.touroklahoma.com/>

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Table 2.1: Variables Included in the Model

Variable names	Description
meanclarity	The average water clarity measurement in a lake for the year (cm)
lakelevel	The average deviation from normal in the months of June, July and August (feet)
campsites	The number of campsites on the lake
boatramps	The number of boat ramps on the lake
shoreacres	The ratio of shoreline miles to lake acres (miles/acre)
statepark	0,1 indicating the presence of a state park on the lake.
distance	Distance from the closest metropolitan area (Tulsa, Oklahoma City, Dallas) (miles)
lakedepth	Normal water elevation as indicated by the Corp of Engineers (feet)

As shown in Table 2.2, the results indicate that the regression is about to explain about two-thirds of variation in visitation levels. The model also shows that above normal lake levels lead to decreased visitation. As one would expect, lakes with more facilities, such as campsites and state parks, have higher levels of visitation. Lakes with a higher ratio of shoreline to lake acres receive fewer visitors. These would be narrower lakes with many bays and inlets. The number of boat ramps also significantly influences the level of visitation.

To evaluate the potential effect of water quality on visitation at COE lakes, we used the average water clarity of the lake. In other specifications, we used the minimum and maximum water clarity measurements for the season. Our analysis indicates that none of the indicators for water clarity were found to significantly predict visitation. Thus, aggregate visitation for the COE sites for the years 2000 to 2007 was not impacted by variation in water quality, as measured by water clarity levels. The model results also show that there is no significant time trend in visitation across the sites. These results provide further support for our conclusion that recreation at Tenkiller Lake has not been impacted by changes in water quality and that recreators have not experienced any potential losses from alleged injuries attributable to increased phosphorous loadings from the application of poultry litter.

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Table 2.2: Recreation Model Results

Invisits	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
meanclarity	.0029796	.0019299	1.54	0.125	-.0008351	.0067942
lakelevel	-.0475354	.0235078	-2.02	0.045	-.0940003	-.0010706
campsites	.0034361	.0007994	4.30	0.000	.0018559	.0050163
boatramps	.1165248	.0303536	3.84	0.000	.0565287	.1765209
shoreacres	-24.80669	6.60842	-3.75	0.000	-37.86873	-11.74465
Indistance	-.3431398	.1019084	-3.37	0.001	-.5445693	-.1417103
statepark	.2224358	.1223296	1.82	0.071	-.0193577	.4642294
lakedepth	-.0002408	.0001781	-1.35	0.178	-.0005927	.0001112
y2001	-.0227072	.1968977	-0.12	0.908	-.4118902	.3664758
y2002	.0569172	.195921	0.29	0.772	-.3303353	.4441697
y2003	.0123243	.198466	0.06	0.951	-.3799587	.4046073
y2004	.0737207	.1960291	0.38	0.707	-.3137455	.4611868
y2005	-.1082455	.1975569	-0.55	0.585	-.4987316	.2822406
y2006	-.2467322	.1997219	-1.24	0.219	-.6414976	.1480332
y2007	-.0474614	.2427033	-0.20	0.845	-.5271826	.4322598
_cons	13.26871	.6123233	21.67	0.000	12.0584	14.47901

2.4 References

Bettman, J.R., M.F. Luce, and J.W. Payne. 1998. "Constructive Consumer Processes." *Journal of Consumer Research* 25: 187-217.

Breffle. 2004. Memo. (Stratus0026104_Breffle_Ques_trip.doc)

Field and Stream. 2008. "The Best Fishing Towns in America." <http://www.fieldandstream.com/photos/gallery/kentucky/2008/01/best-fishing-towns-america?photo=15#>

Frederick, S. and B. Fischhoff. 1998. "Scope (in)sensitivity in Elicited Valuations." *Risk, Decision, and Policy* 3: 109-123.

Greater Tenkiller Area Association. 2009. Lake Tenkiller 2009 Visitor's Guide.

Leggett, Christopher G., Naomi S. Kleckner, Kevin J. Boyle, John W. Duffield, and Robert Cameron Mitchell. 2003. "Social Desirability Bias in Contingent Valuation Surveys Administered Through In-Person Interviews." *Land Economics* 79(4): 561-575.

Oklahoma Department of Wildlife Conservation. 2007. "Oklahoma Bass Tournaments: Annual Report 2007."

Oklahoma Department of Wildlife Conservation. 2004. "Oklahoma Bass Tournaments: Annual Report 2004."

Oklahoma Department of Wildlife Conservation. 2003. "Oklahoma Bass Tournaments: Annual Report 2003."

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Oklahoma Department of Wildlife Conservation. 2002a. "Oklahoma Bass Tournaments: Annual Report 2002."

Oklahoma Department of Wildlife Conservation. 2002b. "Largemouth Bass Electrofishing Results 2002."

<http://www.wildlifedepartment.com/electrofishing2002.htm>

Oklahoma Department of Wildlife Conservation. 2001. "Oklahoma Bass Tournaments: Annual Report 2001."

Payne, J.W., J.R. Bettman, and D.A. Schkade. 1999. "Measuring Constructed Preferences: Towards a Building Code." *Journal of Risk and Uncertainty* 19: 243-270.

Rea, Louis M. and Richard A. Parker. 2005. *Designing and Conducting Survey Research: A Comprehensive Guide*. San Francisco: Josey-Bass Publishers.

Stratus 2008. "Short Report for Lake Tenkiller and Illinois River Recreational Use (LT/IRRU) study – Draft."
(Stratus0026231_LTIR_RU_short_for_main_report.doc)

Stratus 2007. "Oklahoma Watershed Short Telephone Survey Report (Draft)." March 29. (Stratus0027772_STS.Draft_NEW.doc)

Tourangeau, Roger, Lance J. Rips, and Kenneth Rasinski. 2000. *The Psychology of Survey Response*. Cambridge: Cambridge University Press.

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3. ANALYSIS OF REAL ESTATE PROPERTY VALUES ON AND SURROUNDING TENKILLER LAKE

Real estate property values offer yet another way to objectively measure whether or not consumers perceive a decline in value of Tenkiller Lake as a result of reduced water quality or other potential aesthetic effects, such as those alleged in the Stratus CV questionnaire. As we outline here, there is no evidence that property values on and surrounding Tenkiller Lake have exhibited any decline or stagnation over a 14 year period from 1995 to 2008 during which plaintiffs claim declining water quality.

In order to test whether the value of properties located near Tenkiller Lake were affected by phosphorous, we compared it to a similar lake that is not allegedly contaminated with phosphorus: Lake Eufaula.⁸ While Lake Eufaula is considerably larger than Tenkiller, both lakes are approximately the same distance from two major cities: Tulsa and Oklahoma City. Similarly, they are approximately the same distance from Tulsa International Airport. Other than scuba diving, both lakes offer similar recreational activities such as fishing, boating, camping, swimming, golfing, et cetera. As noted in the previous section, both lakes are managed by the COE. Both also support similar levels of recreation activity. The table below outlines similarities and differences between the two lakes.

Table 3.1: Similarities and Differences between Lake Tenkiller and Lake Eufaula

Lake Tenkiller	Lake Eufaula
Man-made, clear water, good for scuba-diving	Man-made
130 miles of shoreline, 12,900 surface acres	600 miles of shoreline, 102,200 surface acres. Largest lake in OK.
47.7 m from Fort Smith AK, 94.5 m from Tulsa OK, 160 m from OKC	86.4 miles from Ft. Smith AR, 88.2 miles from Tulsa, 134 m from OKC
95 miles from Tulsa International Airport	88.7 miles from Tulsa International Airport
Nearby communities: Cookson, Keys, Gore, Sallisaw, Tahlequah, Vian	Nearby communities: Checotah, Eufaula, Kiamichi, McAlester, Muskogee, Stigler, Crowder

⁸ While Tenkiller Lake is on Department of Environmental Quality's 303(d) list (September 2008, Appendix C) for being aesthetically impaired due to phosphorus, no parts of Lake Eufaula are on the list for phosphorus impairment.

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Other things being equal, a home located on or near a lake that is aesthetically impaired would be expected to have a lower price than a similar house located lake that is not impaired. As such, if Tenkiller Lake is aesthetically impaired, then we would expect the property values to be significantly and negatively affected by being located on or near Tenkiller Lake. Michael, Boyle and Bouchard (2000) find that decreases in water clarity as a result of eutrophication lead to reduced property values in Maine lakes. Gibbs, et al. (2002) find similar results for lakefront property in New Hampshire where decreased water clarity resulted in property value reductions ranging from .9 to 6 percent. Gibbs, et al. (2002) indicate that the implicit prices for improved water quality are comparable between the two states, despite differences in the sizes and other characteristics of lakes between the two states. Poor, Pessagno, and Paul (2007) evaluate the effects of changes in total suspended solids and dissolved inorganic nitrogen on property values in the St. Marys watershed. They found that poorer water led to reduced property values.

However, even if Eufaula Lake and Tenkiller Lake were not comparable lakes, i.e., there are characteristics that differentiate the two lakes, we would expect that as the alleged phosphorus problem worsened over time, the relative effect on home prices would be negative. For example, due to its size and location, Eufaula Lake may be windier and have less water clarity than Tenkiller Lake, which is "one of a handful of clear water lakes in Oklahoma," where as Lake Eufaula is not.⁹ Based on this information, we might expect that a home located on Tenkiller Lake would have an increased value based solely on water clarity. However, if there was an increasing water quality problem over time at Tenkiller Lake that was not present at Eufaula Lake, then we would expect to find homes at Tenkiller Lake to appreciate at a slower rate than homes on Eufaula Lake, or possibly decline. In other words, as the (theoretical) water quality problem at Tenkiller Lake worsened, the effect on home price would become relatively negative.

⁹ Lake Tenkiller, Oklahoma," www.outdoors.ok.com/Oklahoma/Tenkiller, Accessed March 26, 2009 and "Lake Eufaula, Oklahoma," www.outdoors.ok.com/Oklahoma/Eufaula, Accessed March 26, 2009.

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3.1 Data

In order to test whether alleged pollution in Tenkiller Lake has had a negative effect on home price value, we collected sales transaction data on single family homes in neighborhoods located within a mile of Northwest Lake Eufaula (McIntosh County, OK) and Tenkiller Lake (Cherokee County and Sequoyah County, OK) from CountyAssessor.info.¹⁰ Below is a map of the counties for which data were collected. Because there are areas of Eufaula Lake that have been identified as “impaired” by the Oklahoma Department of Environmental Quality¹¹ we only collected data for homes sold in McIntosh County, the county containing the northwest area of the lake.¹²

Figure 3.1: Counties for Which Data Was Collected



¹⁰ County Assessor Offices represent that the data represents sales transaction data (where there is a buyer and seller) and not assessment data. However, there were 73 instances where a single property had more than one transaction in a single year; these transactions were excluded.

¹¹ Eufaula Lake, Canadian River Arm, and Longtown Creek Arm are identified as being impaired due to “Oxygen, Dissolved.” In addition, the Canadian River Arm is identified as being impaired due to Turbidity and Color. The source of all impairments is “Unknown” (140). See Appendix C to Oklahoma Department of Environmental Quality. 2008. “Water Quality in Oklahoma: 2008 Integrated Report.”

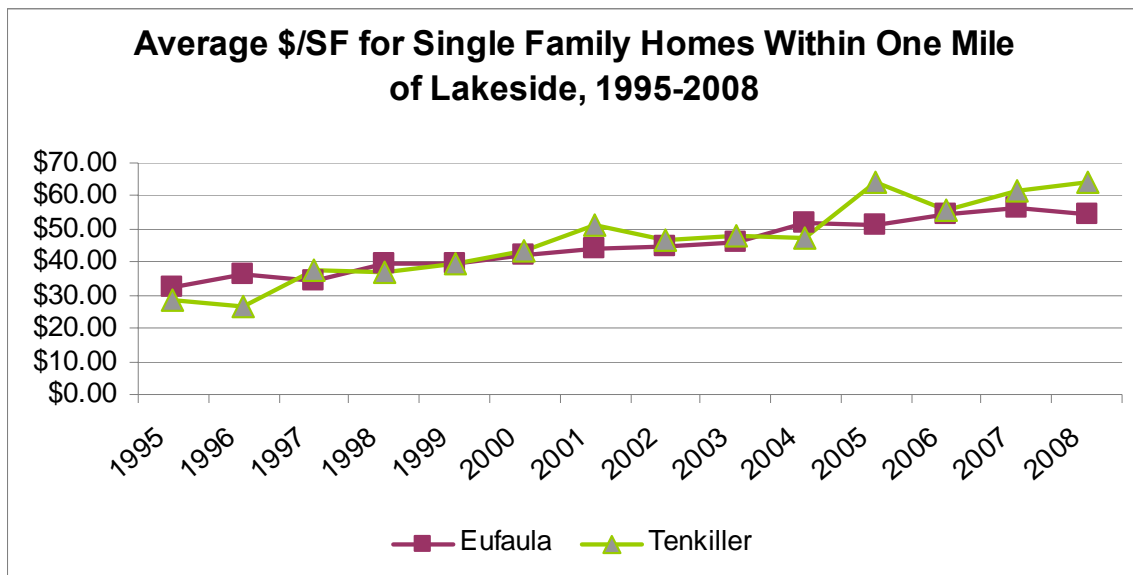
¹² Note that there are some areas in the southern area of McIntosh County that Plaintiffs may allege to be “Substantially Affected by Poultry Operations.” Therefore, we have conducted a sensitivity analysis including and excluding the subdivisions located in this area. The results presented here are consistent whether or not properties located in southern McIntosh County are included.

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Sales Price per Square Foot, 1995-2008

Plotting the price per square foot for Tenkiller Lake and Lake Eufaula shows that sales price per square foot was very similar at the two lakes between 1995 and 2008.¹³ In addition, price per square foot increased at approximately the same rate during that time period. As noted above, the previous literature (Gibbs, et al. 2002; Michael, Boyle, and Bouchard 2000) has shown that decreases in water quality, measured through changes in the clarity of the water, will lead to reduced property values, especially for lakefront property. Based on our comparison, we do not find any appreciable difference between Tenkiller Lake and Lake Eufaula. The chart below reports the data within one mile of each of the respective lakes for 1995 to 2006.¹⁴

**Figure 3.2: Average \$/SF for Single Family Homes
within One Mile of Lake, 1995 - 2008**



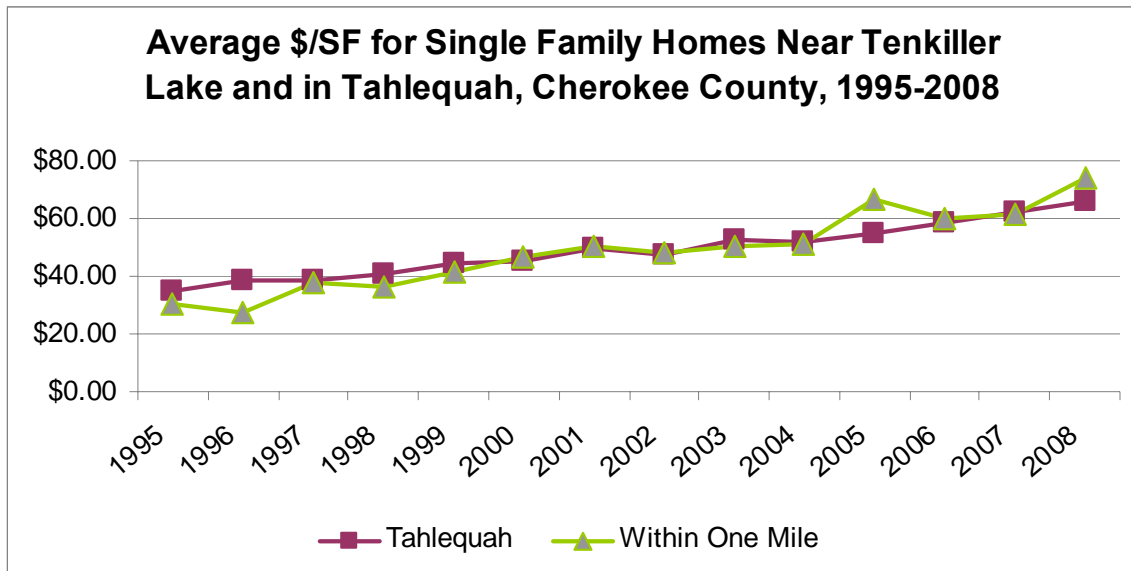
Similarly, comparing the average price per square foot for homes within a mile of the lake to homes in nearby Tahlequah shows that price per square foot was similar in magnitude and change during 1995-2008.

¹³ Although there was transaction dating back to 1987 for Lake Eufaula, there are less than 20 transactions per year for Tenkiller Lake until 1995.

¹⁴ Results are very similar for homes within a half mile of each lake.

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Figure 3.3: Average Price per Square Foot for Homes Near Tenkiller Lake and Homes in Tahlequah, Cherokee County, 1995 - 2008



3.2 Comparative Value of Tenkiller versus Eufaula Lake

There is wide variation of attributes of the single family home. Hence, it is necessary that we control for these various attributes that are expected to affect the transaction price of single family homes located near each of the two lakes. These attributes include square feet, the number of bedrooms and bathrooms, the condition of the building (Average, Excellent, Fair, Good, or Poor), age of the house at sale date,¹⁵ air/ventilation type (forced air, heat pump, none, window unit, zoned F/A), and time. By using standard regression analysis, we found that the coefficient for Tenkiller Lake is positive and significant (at the 10% level) for homes within one mile of the lake, while the coefficient is positive, but not significant for homes located within a half mile of the lake. In other words, the effect on sales prices for properties within both one half and one mile on Tenkiller Lake for the past fourteen years is positive relative to comparable properties on Eufaula Lake and significantly positive for homes within one mile of the lake. Accordingly, there is no evidence, based on actual market transactions, that water quality has negatively impacted the valuation of single family homes on Tenkiller Lake.

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Regression results are shown below. While the coefficient (“coef.”) shows the effect (i.e., positive or negative) of the independent variable on the log of price, the p-value (“P>t”) indicates whether the effect is statistically different from zero. Almost all of the independent variables are significant to the 10% level except for log_bedrooms, log_sale_age, and condition_3 (“fair” condition relative to “poor” condition) in the model for homes within one mile of the lake (Table 3.2). For homes within a half mile of the lake (Table 3.3), condition_3 becomes significant while lake_tenkiller is no longer significant.

**Table 3.2: Regression Results for Homes Sold
between 1995 and 2008 within One Mile of the Lake¹⁶**

Number of obs = 1348						
F(15, 1332) = 105.83						
Prob > F = 0.0000						
R-squared = 0.5471						
Root MSE = .49416						
		Robust				
log_price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
log_sf	0.712	0.052	13.6	0.000	0.609	0.815
log_bedrooms	-0.022	0.066	-0.34	0.737	-0.151	0.107
log_bathrooms	0.291	0.061	4.77	0.000	0.171	0.411
log_sale_age	-0.023	0.023	-1.02	0.307	-0.068	0.021
lakeside_half	0.295	0.051	5.8	0.000	0.195	0.394
ventillation_1	0.451	0.072	6.26	0.000	0.310	0.593
ventillation_2	0.516	0.133	3.87	0.000	0.255	0.778
ventillation_4	0.197	0.071	2.78	0.006	0.058	0.336
ventillation_5	0.444	0.141	3.15	0.002	0.167	0.721
condition_1	0.644	0.159	4.06	0.000	0.333	0.956
condition_2	0.681	0.215	3.17	0.002	0.259	1.103
condition_3	0.261	0.164	1.59	0.111	-0.060	0.583
condition_4	0.857	0.163	5.26	0.000	0.537	1.176
Year	0.039	0.003	11.18	0.000	0.032	0.046
lake_tenkiller	0.062	0.036	1.74	0.082	-0.008	0.132
_cons	-73.761	7.013	-10.52	0.000	-87.520	-60.003

¹⁵ Note that if there was an “effective year built,” this date was used instead of “year built” to account for any property improvements.

¹⁶ Baseline for Ventilation Type is “None” and baseline for Condition is “Poor”. Ventilation Type 1 represents “Forced Air”, Ventilation Type 2 represents “Heat Pump”, Ventilation Type 4 represents “Window Unit” and Ventilation Type 5 represents “Zoned F/A”. Condition 1 represents “Average”, Condition2 Represents “Excellent”, Condition 3 represents “Fair”, Condition 4 represents “Good.”

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**Table 3.3: Regression Results for Homes Sold
between 1995 and 2008 within A Half Mile of the Lake**

Number of obs = 1238						
F(14, 1223) = 92.06						
Prob > F = 0.0000						
R-squared = 0.5169						
Root MSE = .496						
		Robust				
log_price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
log_sf	0.721	0.054	13.45	0.000	0.616	0.826
log_bedrooms	0.000	0.070	0	0.996	-0.137	0.137
log_bathrooms	0.295	0.063	4.68	0.000	0.172	0.419
log_sale_age	-0.016	0.025	-0.66	0.509	-0.065	0.032
ventillation_1	0.455	0.079	5.76	0.000	0.300	0.610
ventillation_2	0.525	0.135	3.88	0.000	0.259	0.791
ventillation_4	0.199	0.078	2.55	0.011	0.046	0.352
ventillation_5	0.426	0.148	2.88	0.004	0.135	0.716
condition_1	0.679	0.164	4.13	0.000	0.356	1.001
condition_2	0.723	0.219	3.3	0.001	0.293	1.154
condition_3	0.292	0.171	1.71	0.088	-0.043	0.627
condition_4	0.891	0.169	5.29	0.000	0.560	1.221
Year	0.039	0.004	10.58	0.000	0.032	0.047
lake_tenkiller	0.053	0.036	1.47	0.142	-0.018	0.123
_cons	-74.281	7.475	-9.94	0.000	-88.945	-59.616

We also tested whether there was a significant change in the effect of a home being located on Tenkiller Lake over time. As previously stated, if the water quality at Tenkiller Lake was declining over time, we would expect the effect of being located on Tenkiller Lake to become negative over time. To test whether or not this was true, we introduced an "interactive term" based on a sale taking place near Tenkiller Lake and the year of the sale. The coefficient on this interactive term (tenkill_yr) measures the effect of being on Tenkiller Lake for the given year. While the interactive term is always positive, it has a *significantly* positive effect on sales price in 2000, 2001, and 2005 for homes within a mile of the lake (Table 3.4). Results are similar for homes within a half mile of the lake (Table 3.5). Thus, we find the evidence shows that sales prices on Tenkiller Lake compared to Lake Eufaula have not varied during the fourteen year time period, contradicting allegations made by plaintiffs that reduced water quality in Tenkiller Lake has resulted in a less desirable place in which to live and recreate.

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Moreover, this would further indicate that there is no observed decline in value due to allegedly lower water quality on Tenkiller Lake.

**Table 3.4: Regression Results for Homes Sold
between 1995 and 2008 within One Mile of the Lake¹⁷**

Number of obs = 1348						
F(28, 1319) = 59.05						
Prob > F = 0.0000						
R-squared = 0.5545						
Root MSE = .49255						
		Robust				
log_price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
log_sf	0.720	0.053	13.69	0.000	0.617	0.823
log_bedrooms	-0.018	0.066	-0.28	0.782	-0.148	0.111
log_bathrooms	0.284	0.062	4.61	0.000	0.163	0.404
log_sale_age	-0.027	0.022	-1.22	0.222	-0.071	0.017
lakeside_half	0.293	0.050	5.84	0.000	0.195	0.392
tenkill_year95	0.092	0.214	0.43	0.666	-0.327	0.512
tenkill_year96	0.144	0.157	0.92	0.358	-0.163	0.452
tenkill_year97	0.068	0.178	0.38	0.703	-0.282	0.418
tenkill_year98	(dropped)					
tenkill_year99	0.257	0.172	1.49	0.136	-0.081	0.596
tenkill_year00	0.373	0.159	2.35	0.019	0.061	0.685
tenkill_year01	0.406	0.174	2.34	0.019	0.066	0.747
tenkill_year02	0.252	0.169	1.49	0.138	-0.081	0.584
tenkill_year03	0.187	0.159	1.18	0.239	-0.124	0.499
tenkill_year04	0.112	0.204	0.55	0.582	-0.288	0.513
tenkill_year05	0.434	0.167	2.6	0.009	0.106	0.762
tenkill_year06	0.017	0.179	0.1	0.923	-0.335	0.369
tenkill_year07	0.052	0.191	0.27	0.785	-0.323	0.428
tenkill_year08	0.200	0.187	1.07	0.285	-0.167	0.567
ventillation_1	0.444	0.073	6.08	0.000	0.301	0.588
ventillation_2	0.525	0.142	3.69	0.000	0.246	0.803
ventillation_4	0.186	0.071	2.61	0.009	0.046	0.325
ventillation_5	0.445	0.142	3.12	0.002	0.165	0.724
condition_1	0.658	0.161	4.09	0.000	0.343	0.974
condition_2	0.684	0.216	3.17	0.002	0.260	1.107

¹⁷ Baseline for Ventilation Type is "None" and baseline for Condition is "Poor". Ventilation Type 1 represents "Forced Air", Ventilation Type 2 represents "Heat Pump", Ventilation Type 4 represents "Window Unit" and Ventilation Type 5 represents "Zoned F/A". Condition 1 represents "Average", Condition2 Represents "Excellent", Condition 3 represents "Fair", Condition 4 represents "Good".

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Number of obs = 1348						
F(28, 1319) = 59.05						
Prob > F = 0.0000						
R-squared = 0.5545						
Root MSE = .49255						
		Robust				
log_price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
condition_3	0.275	0.166	1.66	0.097	-0.050	0.601
condition_4	0.866	0.165	5.25	0.000	0.543	1.190
Year	0.039	0.004	10.18	0.000	0.031	0.046
lake_tenkiller	-0.126	0.136	-0.93	0.353	-0.394	0.141
_cons	-73.061	7.640	-9.56	0.000	-88.048	-58.074

**Table 3.5: Regression Results for Homes Sold
between 1995 and 2008 within A Half Mile of the Lake**

Number of obs = 1238						
F(27, 1210) = 49.52						
Prob > F = 0.0000						
R-squared = 0.5247						
Root MSE = .49491						
		Robust				
log_price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
log_sf	0.729	0.054	13.51	0.000	0.623	0.835
log_bedrooms	0.004	0.070	0.05	0.958	-0.134	0.141
log_bathrooms	0.288	0.064	4.53	0.000	0.163	0.413
log_sale_age	-0.021	0.024	-0.87	0.386	-0.069	0.027
tenkill_year95	0.075	0.218	0.34	0.731	-0.354	0.504
tenkill_year96	0.125	0.164	0.76	0.445	-0.196	0.447
tenkill_year97	0.049	0.186	0.26	0.793	-0.316	0.413
tenkill_year98	(dropped)					
tenkill_year99	0.236	0.178	1.32	0.186	-0.114	0.586
tenkill_year00	0.347	0.166	2.09	0.037	0.022	0.673
tenkill_year01	0.370	0.183	2.02	0.044	0.011	0.729
tenkill_year02	0.223	0.176	1.27	0.205	-0.122	0.568
tenkill_year03	0.123	0.164	0.75	0.454	-0.199	0.445
tenkill_year04	0.083	0.210	0.39	0.693	-0.328	0.494
tenkill_year05	0.373	0.173	2.15	0.032	0.032	0.713
tenkill_year06	-0.016	0.186	-0.09	0.931	-0.381	0.348
tenkill_year07	-0.018	0.198	-0.09	0.926	-0.408	0.371
tenkill_year08	0.163	0.198	0.82	0.410	-0.226	0.552
Ventilation_1	0.449	0.080	5.61	0.000	0.292	0.606

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Number of obs = 1238						
F(27, 1210) = 49.52						
Prob > F = 0.0000						
R-squared = 0.5247						
Root MSE = .49491						
		Robust				
log_price	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
ventillation_2	0.533	0.144	3.69	0.000	0.250	0.817
ventillation_4	0.189	0.079	2.41	0.016	0.035	0.343
ventillation_5	0.432	0.150	2.89	0.004	0.139	0.726
condition_1	0.697	0.166	4.19	0.000	0.370	1.023
condition_2	0.725	0.221	3.29	0.001	0.293	1.158
condition_3	0.309	0.172	1.79	0.074	-0.029	0.647
condition_4	0.905	0.171	5.3	0.000	0.570	1.240
Year	0.040	0.004	9.75	0.000	0.032	0.048
lake_tenkiller	-0.101	0.144	-0.7	0.486	-0.383	0.182
_cons	-75.150	8.209	-9.15	0.000	-91.255	-59.045

3.3 References

Bureau of Labor Statistics. 1980-2009. "Consumer Price Index – All Urban Consumers, CUUR0300SA0, South urban, All items, Base Period 1982-84=100."

County Records, Inc., PvPlus Database of Assessor's records acquired from the County Offices of Cherokee County, Sequoyah County, and McIntosh County in Oklahoma. Accessed March 25-26, 2009 from <http://countyassessor.info>.

Entire Lakes Report Executive Summary, "Eufaula Lake," Oklahoma's Beneficial Use Monitoring Program – Lakes Sampling, 2006-2007 Draft Report, pp. 184 – 194.

Gibbs, Julie P., John M. Halstead, Kevin J. Boyle, and Ju-Chin Huang. 2002. "An Hedonic Analysis of the Effects of Lake Water Clarity on New Hampshire Lakefront Properties." *Agricultural and Resource Economics Review* 31(1): 39-46.

"Lake Eufaula, Oklahoma," www.outdoors.ok.come/Oklahoma/Eufaula. Accessed March 26, 2009.

"Lake Tenkiller, Oklahoma." www.outdoors.ok.come/Oklahoma/Tenkiller. Accessed March 26, 2009.

Michael, Holly J., Kevin J. Boyle, and Roy Bouchard. 2000. "Does the Measurement of Environmental Quality Affect Implicit Prices Estimated from Hedonic Models?" *Land Economics* 76(2): 283-298.

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Oklahoma Department of Environmental Quality. 2008. "Water Quality in Oklahoma: 2008 Integrated Report." Appendix C.

Poor, P. Joan, Keri L. Pessagno, and Robert W. Paul. 2007. "Exploring the hedonic value of ambient water quality: A local watershed-based study." Ecological Economics 60: 797 - 806.

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4. CRITIQUE OF CONTINGENT VALUATION SURVEY

This section describes the numerous biases in the Stratus CV survey questionnaire and key survey findings. As shown above, only after finding the unsatisfactory results (from their perspective) using the methods based on unbiased estimates of actual behaviors, did the plaintiffs' experts turn to the CV methodology. This methodology has been shown to be subject to substantial hypothetical biases, especially for passive users or nonusers, stemming from flaws in the survey questionnaire, as well as the survey administration. The Stratus CV survey describes a hypothetical referendum for a restoration project that would restore water clarity and ecosystem services to levels purported to have existed in the 1960s. Two important questions that we consider about this hypothetical referendum are whether the description is consistent with the appropriate conceptual economic underpinnings and whether respondents processed the description in the way that the analysts intended. Of course, that intention should be such that people's responses are elicited in a way that minimizes the potential for bias. The Stratus questionnaire and survey embodies numerous critical flaws in the description of the hypothetical commodity that render the survey responses invalid and the results unreliable for use in a damage assessment. Specifically, our analyses demonstrate that:

- The CV survey questionnaire contains biased and misleading information.
- CV survey respondents are valuing a commodity other than a faster recovery of the algae conditions for the Illinois River and Tenkiller Lake.
- The CV results contain substantial hypothetical bias.
- The CV results are an artifact of the hypothetical bid structure.
- The CV survey results suffer from nonresponse bias.

Each of these flaws, among others, is discussed below.

4.1 The CV survey questionnaire contains biased, misleading, and factually incorrect information.

Maintaining neutrality in a questionnaire is of critical importance in any survey, but especially in surveys used in litigation. The survey literature contains many

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examples of the effects of non-neutral wording in biasing results (Rea and Parker 2005; Rossi, Wright, and Anderson 1983). The NOAA Panel specifically addresses neutrality by emphasizing the importance of a conservative design (Arrow, et al. 1993). While no set protocol exists for determining what constitutes neutral and conservative language, researchers should, at the very least, present balanced and unbiased information when describing the environmental issues.

The Stratus CV survey purports to provide respondents with an impartial description of the background regarding water quality conditions in the Illinois River System and Tenkiller Lake. In fact, the Stratus CV questionnaire is anything but balanced and unbiased. Examples of the bias are littered throughout the questionnaire. Among the most egregious examples of bias in the Stratus survey are the representations of the safety and efficacy of the proposed alum restoration project. Specifically, the survey questionnaire states that:

Alum is used to keep pickles crisp, and you can buy alum powder in the grocery store for many uses, including cooking and making “play dough” for children.

If alum is put on land, it attaches to phosphorous in the soil to form harmless particles. When these particles wash into rivers and lakes, the particles sink to the bottom and do not help algae grow.

For more than 35 years, alum has been used successfully and safely to remove phosphorous and reduce algae in many states, such as Colorado, Texas, Missouri, South Dakota, Florida, Wisconsin, and Washington.....Experiences in those states have convinced scientists that alum does not harm fish or other things living in water, and that alum treatments here in Oklahoma could safely return the river and Lake to what they were like in around 1960.

Thus, the alum picture painted in the survey (reinforced by the grocery store photograph that shows alum powder in a small spice container next to other spices used by home cooks) is that the alum restoration program would be a safe and effective way to reduce algae in the Illinois River System and Tenkiller Lake.

The safety of alum for fish and other biota is a subject of considerable debate in the scientific community. Specifically, Connolly, Sullivan, and Coale (2009) cite

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numerous references as to the potential risks to fish and other biota from the use of alum in a restoration project. Chief among these problems for fish and other biota are:

- Possible morphological deformities in benthic communities
- Diminished survival of some spring spawning fish and bottom-dwelling amphibians
- Possible chronic effects on fish.

Clearly, the Stratus questionnaire provides no mention of such potential risks to fish or other biota (p.18).

Connolly, Sullivan, and Coale (2009) further note the risks to forage grasses from the application of alum to pasture lands. They indicate that the science of alum restoration for forage grasses is anything but well-developed and that such a large-scale program as proposed in the questionnaire would raise significant technical issues, especially ones related to substantial changes in the acidity of the soils that would require application of other minerals on a large scale to offset the alum impacts. Moreover, Connolly, Sullivan, Coale (2009) indicate that determining the rate of application for alum and the other minerals would have to be done on a field-by-field basis because of the diversity of acidity levels in the soil. Finally, the Stratus questionnaire fails to mention that the alum application would take place on private lands, which would raise significant implementation problems for the hypothetical program. Alum restoration on land would pose substantial risks to forage grasses, which are critical to the economic well-being of the farmers who raise cattle in the Illinois River watershed. None of these risks, or the potential economic trade-offs that may be associated with an alum restoration program, is described in the survey questionnaire.

Connolly, Sullivan, and Coale (2009) indicate that alum restoration projects in other locations have been the subject of considerable controversy among various interest groups, especially nearby residents. They cite case studies in which proposed restoration projects were either delayed for several years, or modified because of public concerns about the safety to fish and shellfish. The Stratus CV survey designers

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presented none of this information about the reaction in other communities to alum restoration projects in the survey questionnaire for the Illinois River System and Tenkiller Lake.

Similarly, the questionnaire fails to reflect the unknown efficacy of the proposed alum treatment. Instead, the implementation of the alum restoration program is described in almost trifling simplicity:

Alum could be spread on land from trucks.

Alum could be spread on the lake from boats.

Alum could be sprayed in river water flowing into Oklahoma from Arkansas.

This restoration program is largely a figment of the survey designers' imagination, not the depiction of a realistic restoration option. Perhaps, the most telling refutation of the alum restoration program comes from the plaintiffs' own restoration consultant, Mr. King. Specifically, in his report, Mr. King states (King 2008, p. 19):

However, in a reservoir, such as Lake Tenkiller, high dosages and repeated applications may be needed to be potentially effective in sequestering sediment P. With higher dosages, there is the potential for localized depression of pH with an associated potential increase in aluminum toxicity to aquatic life.

Alum treatment of Lake Tenkiller could potentially reduce the internal loading of P from lake sediments. Using alum typically increases the water clarity. Alum can be toxic to aquatic life at low pH (Cooke et al., 2005). Alum applications are generally effective in lakes from 5 to 15 years (Welch and Cooke, 1999). However, the duration of alum treatment effectiveness in a reservoir such as Lake Tenkiller will not be as long as a lake and will be further reduced proportional to the additional P inputs from the Illinois River, Caney Creek and the Baron Fork. Therefore, the applicability of P inactivation with alum cannot be adequately evaluated until the final remedial measures for the watershed and riverine response regions have been identified in sufficient detail to determine future P and nutrient loadings to Lake Tenkiller.

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When asked about alum restoration in his deposition, he indicated that he had rejected the option because it was not technically feasible. Specifically, Mr. King states (King 2009, pp. 287-288):

Q. On Page 19, one of these potential treatments you discussed is P inactivation with alum, aluminum sulfate; correct?

A. Yes, sir.

Q. This specific potential remedy or remedial step is one that you are not recommending to be implemented at this time; is that correct?

A. I categorized it as requires additional investigation and assessment.

Q. And does that mean that you cannot recommend it at this time based upon the current data in hand?

A. Yes.

Q. To your knowledge, has anyone done a technical evaluation of the feasibility of treating Tenkiller Reservoir with alum?

A. No, no, not that I can think of.

In addition, the Stratus survey contained “scientific” information about the effects of algae on fish in the Illinois River and Lake Tenkiller. This scientific information is presented in such a way as to convey that there is no scientific debate about the accuracy of the information.¹⁸ The key statements include the following:

- Fewer small mouth bass, other fish and small plants in both the IR and Tenkiller Lake
- Large areas of Tenkiller Lake small mouth bass and other types of fish people catch grow slower and there are fewer of them
- Large areas of the bottom of Tenkiller Lake, there are lot fewer insects and small animals than are in the lakes with less algae
- Large mouth bass have increased in numbers and growing more quickly.

¹⁸ Of course, the questionnaire designers note in the survey that scientists agree that the effects of algae were the result of human activities (p. A-13.) Such a statement is so broad as to be meaningless. Nevertheless, it conveys the impression that scientists agree with all the other information that is presented in the survey, which is inaccurate.

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However, Connolly (2009) offers a very different picture as to the impacts of phosphorous on fish populations in the Illinois River and Tenkiller Lake. For example, he concludes:

- The fish community within the Illinois River Watershed is not highly degraded due to water quality impacts. Lower diversity is more of a function in stream-size than reduced water quality.
- Lower diversity is more affected by poor stream habitat than water quality.
- The sample protocols may underestimate the diversity of fish in the Watershed.
- One would expect the bass fishery in Tenkiller Lake to be dominated by largemouth bass, followed by spotted bass, with small mouth bass a minor component due to the habitat requirements of the latter species.

In his deposition, Dr. Cooke, one of the plaintiffs' biological consultants notes that the construction of a dam had a significant impact on small mouth bass in the Illinois River. Specifically, Dr. Cooke states (Cooke 2008, pp. 557-558):

Q. Now, you say in your report that smallmouth bass were abundant in the Illinois River – excuse me, David -- prior to the formation of the lake?

A. Yes.

Q. And when the reservoir was formed, would you and the dam was closed, the lake began to fill, would you agree with me that that created a very different habitat, fish habitat than the flowing Illinois River watershed?

A. I would agree with that.

The CV survey fails to mention any potential impacts from the construction of the dam on the small mouth bass in the Illinois River and Tenkiller Lake, nor does it mention anything about differences in habitat requirements of the various bass species.

The failure to acknowledge any uncertainty among scientists about the potential injuries or the safety and efficacy of alum in the survey questionnaire is a serious flaw. By not reflecting the scientific uncertainty associated with the injury and the restoration program in the survey questionnaire, the survey adds another dimension for biasing the

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survey results to generate a higher damage estimate. The existing literature on uncertainty clearly demonstrates that including such information would have substantially altered the responses. Specifically, it has long been known from the psychological literature that people have a very difficult time answering questions where uncertainty is present. In particular, the literature shows that people's preferences are often poorly formed, are very sensitive to the way questions are framed, and that people are unable to process probabilistic information (Tversky and Kahneman 1981; Slovic, Fischhoff, and Lichtenstein 1982). One research finding that is particularly pertinent to the Stratus CV questionnaire is the so called "certainty effect" (Weinstein and Quinn 1983; Tversky and Kahneman 1981). People respond to questions quite differently when one of the options presented involves a certain outcome. Thus, the Stratus questionnaire presents respondents with a biased, inadequate basis for evaluating the hypothetical restoration program, rendering the results invalid.

Another facet of bias in the CV questionnaire involves the discussion of the poultry industry as the primary source of the algae growth. Specifically, the questionnaire tells respondents that "60 percent of the phosphorous in the IR and TenKiller Lake is from chickens and turkeys." This statement, the accuracy of which is attributed to Dr. Engel's various reports, is of critical importance to the survey designers. Without it, they have no way to associate the phosphorous loads to the Illinois River and Tenkiller Lake with the application of poultry litter.¹⁹ As Connolly, Sullivan, and Coale (2009) state, Dr. Engel's methodology that produces the 60 percent estimate is without scientific foundation. In addition, Dr. Bierman (2009) concludes that Engel's approach is an inappropriate tool for predicting watershed nonpoint source phosphorous loads. Dr. Bierman further concludes that Engel's approach is inconsistent with accepted practices in the scientific community and that it contains numerous and substantial errors. Survey respondents are provided none of this

¹⁹ The survey questionnaire fails to explicitly tell people what will happen to the other forty percent of future phosphorous loads to the Illinois River. Survey respondents likely derived the impression that the combination of alum treatments and the ban on poultry applications would remove both the past and future phosphorous loads from all sources. Of course, if respondents believed such an outcome would occur, their votes would be based on a perception that exceeds the scope of the injury alleged by the plaintiffs in this case.

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information about the questions concerning the scientific validity of Dr. Engel's 60 percent estimate.

Moreover, the questionnaire contains a specific and detailed focus on poultry litter as the cause of the algae. The questionnaire emphasizes the role of the poultry industry by enumerating that 140 million chickens and turkeys are raised each year within the watershed and that these birds produce more than 300,000 tons of litter annually. Other than mentioning, in passing, that the 40 percent of phosphorus attributable to other sources includes sewage treatment and store-bought fertilizer applications and the cattle industry, there is no comparable specificity for these other sources. That is, the questionnaire is silent on the number of individual septic fields within the watershed, the number of households served by sewage treatment facilities within the watershed, and the number of acres of lawns and golf courses to which store-bought fertilizer is applied (among other potential sources of phosphorus). The lack of specificity about the other sources of phosphorus results in an unbalanced and biased questionnaire.

The restoration recovery periods are a critical component of the hypothetical scenarios in the Stratus survey questionnaire. The survey describes the natural recovery for the river and the lake once the ban on poultry litter application was imposed. However, Connolly, Sullivan, and Coale (2009) conclude:

As a result, the statements by Stratus in their Survey that the river and lake would recover to 1960's conditions in about 60 and 50 years, respectively, once poultry litter application was stopped, can not be supported. The models developed by the Plaintiffs can not provide an accurate measurement of this "time to recovery" as they are currently developed and applied. (p.13)

Moreover, Connolly, Sullivan, and Coale (2009) further conclude that there is no scientific basis for the survey's contention that the alum restoration program would speed the return of water quality to its purported historical levels. Specifically, they state:

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However, no scientific basis is given in Chapman et al. (2009) for this 40-year acceleration. The one citation given in the Chapman et al. (2009) report for alum treatment in the watershed (Cooke et al. 2005) actually states that alum treatment of reservoirs is uncommon and somewhat discourages direct application of alum in flowing rivers (see Section 3 of this report for further discussion). Nowhere in Cooke et al. (2005) is information provided that would allow one to quantify the acceleration of recovery using alum (p.13).

In terms of balance, omitting relevant counter-arguments from the text can further bias the respondent. Schuman and Presser (1981) find “that the effects of adding counter-arguments are too pervasive and too large to allow the question forms...to be treated as interchangeable....” In other words, adding counter arguments provides such great changes in response outcomes that questions which provide counter arguments cannot be treated as identical to questions which do not provide counter arguments. The counter argument gives the respondent who has not previously considered an issue a plausible reason for choosing the other side of the issue. Schuman and Presser state: “The counter argument thus provides a genuine degree of cognitive persuasion, and is not merely a matter of social pressure.” Specific counterarguments for the restoration program might be that the program has not been fully evaluated by scientists and the potential economic tradeoffs in the form of higher costs to farmers who grow hay as well as cattle ranchers.

Respondents’ open-ended comments indicate that this questionnaire was not sufficiently balanced in terms of counter-arguments. Near the end of the survey, the questionnaire asks respondents whether they felt pushed to vote in a certain direction. Despite the almost hour long in-person interview dosing respondents with information about water quality impacts from the poultry industry, almost 9 percent of the respondents to the base questionnaire admitted that they felt pushed to vote for the alum treatments.²⁰ When asked why they felt this way, they responded:

- “Because it totally disregarded other things in the land and just spoke of alum and phosphorus”

²⁰ This percent likely understates the percentage of respondents who felt pushed because of their unwillingness to express opinions that the interviewers might have viewed as being critical of the survey. This is another indication of the tendency that respondents have to want to please survey interviewers discussed above.

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- “Because it does not discuss the socio-economic ramifications as in the poultry farmers, the communities supported by jobs in the poultry farms, monies lost by businesses like corn seed, doesn’t discuss the higher cost of food such as poultry”
- “Excess information about the treatment”
- “It seems one-sided. The State wants to do it, so it’s pushing for the alum treatments.”
- “It seemed to only offer evidence to positive effect, but it didn’t seem to offer any side effects to the contrary.”
- “It did not provide enough contradictory information regarding the alum treatments.”
- “Just showed one side.”
- “It seemed to only offer evidence to positive effect but didn’t seem to offer any side effects to the contrary.”
- “Gave a more positive picture of the alum treatments than not.”
- “I think I heard only one side of the story.”
- “This was a state infomercial.”
- “The statements did seem slanted towards the alum treatments. If I had not heard, I probably would have voted against them.”
- “Most of the information was positive for the alum treatments. I would like to hear about other states that have used and any other side effects from it.”
- “Because the opinions of the opposite parties involved were not included.”
- “I didn’t want to vote for something that would hurt farmers and thought it emphasized poultry litter too much, not 60%. I thought that the sewage and chemical fertilizer might affect the river more.”
- “The pictures are taken to specially convince me about the algae. The picture cards e, f, and g are taken to make me vote for them.”
- “That’s why they are spending all this money to send you all here. So we will vote for a tax increase.”

Clearly, based on the responses above as well as the other arguments described earlier, the Stratus questionnaire is seriously deficient in presenting counter arguments.

The photos used to depict the increase in algae are also relevant to the discussion of neutrality and conservative design (Mathews, Freeman, and Desvousges

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2007; Arrow, et al. 1993; Mitchell and Carson 1989). Recall the respondent comment above that the photos were “specially taken to convince me about the algae.” Because “a picture is worth a thousand words,” photos are efficient survey tools. That efficiency is accompanied by the creation of an indelible image in the minds of the respondents. Although the Stratus team claims to use photos that show “relatively mild” algae growth, the differences are striking. They are so striking, in fact, that it is easy to forget that those conditions, where they exist in the river, are present only during a few months of the year and confined to limited areas. The interviewers only verbally mentioned these seasonal and spatial differences, making them easier to forget than the images presented in the photos. Moreover, the questionnaire fails to provide any details on how limited the areas might be that are represented in the photographs. Card N, which provides some reasons why the respondent might choose to vote against the alum treatments, is also silent on both the limited seasonal and spatial algae impacts.²¹ A more neutral approach, to provide balance against the photos’ lasting impressions, would have included both the seasonal and spatial limits on the algae in the photos and would have reminded respondents of these limits just prior to voting as a reason to potentially vote against the program.

Another critically important but biased facet of the Stratus questionnaire is the statement that asks respondents to assume that the Court had decided to impose a ban on the application of poultry litter in the Illinois River watershed. Such a statement is likely to indicate that the Court had already sanctioned the ban, when in fact the Court decided not to impose the temporary injunction sought by the plaintiffs in this case. The likely effect of such a statement is to mislead people to think that the Court agreed that the application of litter was a serious problem. Otherwise, it would not have been stopped. Such a misleading statement imports significant bias making it more likely that respondents would vote for the hypothetical restoration program.

Notifying the respondents of the sponsor of the survey, such as the use of the introductory letter from the State of Oklahoma, may cause them to respond as they believe the sponsor would like them to answer. Presser, Blair, and Triplett (1992) find a

²¹ Connolly, Sullivan and Coale (2009) express criticisms of the photos from a scientific water quality perspective as well.

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significant change in response distribution when the sponsor is named. They hypothesize that this result reflects the conjunction of two factors. First, respondents perceive that the sponsor had taken a clear position on the subject in question. In addition, the issue was one on which it was likely the respondent had not already formed an opinion. This CV survey clearly exhibits both of the qualifications that Presser, Blair, and Triplett (1992) hypothesize to be important: (1) the State clearly has an opinion on this subject or they would not be sponsoring the survey, and (2) because the scenario is hypothetical, respondents could not have previously formed an opinion.

Results from the earlier telephone survey conducted by Stratus likely influenced the information content in the CV questionnaire. As described above in Section 2.2, Stratus conducted a telephone survey of Oklahoma residents in 2006 to assess the knowledge and use of the Illinois River System and Tenkiller Lake, to determine perceptions about water quality, and to identify any impacts from media coverage of the environmental issues within the watershed (Stratus 2007). Table 4.1 below provides the progression of the questions asked about respondents' impressions of the Illinois River System and Tenkiller Lake.

Table 4.1: Respondents' Impressions and Knowledge about Tenkiller Lake and the Illinois River from 2006 Telephone Survey

Survey Question	Percent of Respondents mentioning poultry litter
"What impression do you have about the Illinois River? Is there anything especially good or bad about the Illinois River?"	6%
"What impression do you have about Tenkiller Lake? Is there anything especially good or bad about the Lake?"	2%
"Have you heard of any issues or concerns relating to the Illinois River or Tenkiller Lake or are you unaware of any issues or concerns there?"	16%
"What about water quality in the Illinois River and Tenkiller Lake? Are you aware of any water quality problems there or have you not heard of any water quality problems?"	26%

As those results show, increasing the amount of prompting and information used in the question can alter the responses to the survey. Respondents tend to agree

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and provide the interviewer with the information they are looking for, which may not necessarily reflect their true impressions or opinions. As more information is given to prompt the respondent to provide information about water quality problems, more respondents comply and recognize the issue in their responses. After the telephone survey results were shared with the Stratus team, one member commented: “If estimated damages are to be significant, people will have to be educated about the injuries. There is currently not a lot of knowledge of the injuries” (Morey 2006).

Rather than first ask the 2008 CV respondents the extent of their knowledge and impressions in a manner similar to the 2006 telephone survey, the 2008 CV questionnaire *first* described the environmental issue as viewed by the plaintiffs and *then* asked respondents whether they had heard about these issues. Almost one-third of the 2008 respondents indicated that they had heard about the algae. This higher response may be due in part to respondents not wanting to appear uninformed about issues in their state. It is possible that the increasing media coverage of the Illinois River watershed and the Attorney General's lawsuit has raised awareness. Nevertheless, Stratus chose to not ask the 2008 respondents their impressions prior to “educating” them. Not doing so is inconsistent with a conservative design required by the NOAA Blue Ribbon Panel. Not doing so makes it impossible to disentangle potential nonuse values that respondents may have held prior to taking the survey and the nonuse values that were created during the “education” process that occurred in the CV survey. Thus, the Stratus questionnaire has artificially inflated, and in some instances created, the concerns about water quality in the Illinois River System and Tenkiller Lake by dosing the respondents with new (and, in some cases, flawed and erroneous) information before eliciting their opinions.

4.2 Many survey respondents valued a different commodity than was intended by the survey designers, rendering the results invalid.

A critical requirement for a CV survey is to provide information to respondents about the commodity so that they understand and accept it and can give a meaningful answer to the valuation question. The Stratus CV survey results reveal that respondents did not understand or accept the information in the CV scenario and thus did not value the commodity they were being asked to value—the return of water clarity

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and ecosystem services to levels that purportedly existed in the 1960s. As a result, the CV responses do not reflect the value for water clarity and ecosystem service improvements in the Illinois River and Tenkiller Lake and are, therefore, meaningless.

The problem of information provision and acceptance is a basic concern with hypothetical CV results. The NOAA Panel expressed concerns about information provision and acceptance in its 1993 report:

If CV surveys are to elicit useful information about willingness to pay, respondents must understand exactly what it is they are being asked to value (or vote upon) and must accept the scenario in formulating their responses (Arrow, et al. 1993, p. 4605).

The NOAA Panel's main concern is that respondents sometimes do not value the commodity specified in the survey that researchers assume they are valuing either because of commodity misspecification or scenario rejection. While the distinction between lack of understanding of the commodity and scenario rejection is frequently difficult to make, both problems have the same consequence: respondents are not valuing the commodity that researchers assume they are valuing. As a result, responses to the valuation question are difficult to interpret.

The Stratus CV Survey included several questions following the vote question to assess the respondents' acceptance of the "facts" described by the interviewer. These questions included the respondents' beliefs or understanding about:

- Whether the alum treatments would be implemented without the court-ordered ban
- Whether phosphorus had caused the changes described (or whether the respondent did not believe that the described changes had actually occurred)
- Whether the natural recovery period of the lake or river was different from that stated by the interviewer
- Whether the tax amount paid by each household would be different from that described by the interviewer
- Whether the tax collected would be used to clean up other lakes and rivers in addition to the Illinois River and Tenkiller Lake.

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These data reveal that more than 80 percent of the respondents who voted for the program in the base version of the survey rejected at least one element of the scenario. Nearly 55 percent of them rejected at least two elements, and more than 25 percent of them rejected at least 3 elements. Table 4.2 contains the details.

Table 4.2: Scenario Acceptance Data

Category of rejected elements	Base Version Respondents Who Voted For	
	Number of Respondents	Percent of Respondents
Different Natural Recovery times	399	62%
Other lakes and rivers would also be cleaned up	289	45%
Different Tax Amount	270	42%
Alum Treatments might be implemented without the court-ordered ban	130	20%
Phosphorus had not caused the described changes	36	6%
TOTAL	524	81%
Number Rejecting 2 Elements	183	28%
Number Rejecting 3 Elements	122	19%
Number Rejecting 4 or 5 Elements	54	8%

Two of the results merit further discussion. About 45 percent of the base version respondents who voted for the alum treatments believed that the extra tax money would be used for cleaning up other lakes and rivers. Thus, almost half of the respondents were valuing a much larger commodity when they cast their hypothetical votes.²² This is not the first time that respondents have not followed the exhortations of the survey designers to only value a specific resource. For example, in the Clark Fork River Basin contingent valuation study, the survey designers went to considerable lengths to inform respondents that their answers would only apply to resources in that river basin. However, when they asked people whether they considered only the Clark

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Fork River Basin in developing their answers, approximately 83 percent indicated that they were valuing something other than the Clark Fork River (Diamond and Hausman 1994). Because many survey responses and votes reflect more than the Illinois River System and Tenkiller Lake, the resulting willingness-to-pay (WTP) estimates are not valid.²³ Specifically, they do not “fit” or correspond to the alleged natural resources injuries for the Illinois River System and Tenkiller Lake.

Moreover, respondents formed different assumptions about future phosphorus loads to the river and lake. Although they were told to assume that the alum treatments would occur only if the court ordered a ban on poultry litter spreading, clearly some respondents did not assume that the ban would occur when they hypothetically voted. What these respondents assumed about future phosphorus loads from poultry litter is unknown. What these respondents assumed about how long the water in the Illinois River System and Tenkiller Lake would remain clear in the absence of a ban also is unknown. Moreover, these ambiguities leave one without any sense of what respondents assumed about the future phosphorus load from other sources. Although the questionnaire briefly mentions “other things being done” to reduce (but not eliminate) new phosphorus from other sources, at least some of the future phosphorus loading will continue from other sources. This further complicates the interpretation of what people think they are valuing in this survey. Specifically, some respondents may have thought through the logic and “facts” in the survey and assumed that future phosphorus loadings from other sources would continue, even with the ban and the alum treatments. For that group, the number of future years of water clarity they believed would be achieved likely varied widely because of the differences in beliefs about the number of years natural recovery would take. On the other hand, some respondents likely forgot that other future sources of phosphorus would continue because these sources received so little attention in the questionnaire. The likely conclusion is that these respondents assumed that the ban and alum treatment would result in water clarity into perpetuity. Thus, respondents were valuing different commodities when they hypothetically voted.

²² Section 5 contains the results of an analysis that explores the impact on WTP of valuing this much larger commodity.

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Further evidence can be found that some respondents simply rejected what the survey designers intended for them to believe. For example, about 5 percent of the respondents who voted “for” the alum treatments did so because they were motivated by human health concerns. In a natural resource damage assessment, values related to potential health effects are not included as part of the definition of compensable values. Natural resource damages apply only to the residual injuries to natural resources after remediation is completed. The regulations presume that health considerations are addressed in remediation decisions, not restoration (43 CFR Part 11).

The responses to open-ended comments provide some additional insight that respondents are concerned about the possible consequences on their health and the health of others. Specifically, respondents who voted for the program said that they did so because:

- “Health being a major thing.”
- “Husband had an ear infection as a result of swimming at lake.”
- “A couple of years ago there was an incident of a child dying.”
- “It would help a lot more people not to get sick from swimming.”

Additionally, the published literature on risk perceptions indicates that such perceptions are not easy to change, even if the questionnaire is silent on the issue of human health. The Schulze, et al. (1998) study on Denver air quality demonstrates how difficult it was to get people to focus on just the visibility aspects of air pollution. This study explains that respondents have a “mental model” of environmental effects. Specifically, respondents believe that improvements in air visibility must necessarily be accompanied by improvements in healthiness of the air and other public goods. As a result, respondents with such a mental model embed health values into their responses that were not part of the CV question. It is likely that some respondents used the same type of mental model when answering the valuation question in the Stratus CV study.

²³ According to the Stratus report, respondents who thought that the extra tax payments would be used for cleaning up more rivers and lakes were more likely to vote for the alum treatments. This result is evident in Table 6.26, which indicates the statistical significance of this variable in predicting the voting patterns.

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That is, the respondents assumed that a change in the visual aspects of the water must correspond to improvements in human health. Accordingly, the CV estimates include yet another element that is not related to the compensable value of the natural resource services.

Additionally, interviewer evaluation data from the Stratus survey reveal that some respondents did not understand or did not take the interview and the vote seriously. Following the interview with the respondent, each interviewer answered questions related to his/her opinion of the respondent's understanding and cooperation during the interview process. The interviewer evaluation data reveal that the interviewers indicated comprehension or cooperation issues with 90 respondents who voted for the program in the base version of the survey. Table 4.3 contains the details. Despite these obvious flaws, Stratus did not eliminate these respondents from their damage calculations.

Table 4.3: Interviewer Evaluation Data

	Base Version Respondents Who Voted "For"	
Category	Number of Respondents	Percent of Respondents
Comprehension Problems	37	6%
Distracted	25	4%
Impatient	24	4%
Inattentive	21	3%
Did Not Take Interview Seriously	9	1%
TOTAL Respondents	90	14%

In summary, the differences in understanding and scenario acceptance will cause different respondents to value a different commodity. Because two respondents are valuing different scenarios, their answers will not be comparable. In light of differences in comprehension and acceptance, there is no way to know what assumptions the respondents are making as they answer the questions. Accordingly, there is no way to know what bias these unknown assumptions are introducing into the CV results. However, to the extent that many of these perception problems go beyond

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the specified injuries in the survey questionnaire, the most likely impact is an upward bias in the Stratus damage estimates.

4.3 Hypothetical bias is a fatal flaw in the Stratus CV data.

CV results are not based on actual, observed behavior made by people in an economic market who face the consequences of their decisions. Instead, the results are based on verbal interviews asking unusual questions about potentially unfamiliar, hypothetical situations. If the respondents make different decisions in this hypothetical scenario than they would if faced with the actual situation, then the results will be unreliable and unusable for assessing damages.

The difference between stated intentions and actual behavior is a reflection of hypothetical bias. Researchers recognized hypothetical bias in CV studies nearly 30 years ago, defining it as the “potential error due to not confronting an individual with a real situation” (Rowe, d’Arge, and Brookshire 1980, p. 6).²⁴ In effect, the hypothetical nature of CV does not provide respondents with an incentive to reveal their true values because they do not have to bear the consequences of any answers they provide in a survey. Common sense suggests that people simply will not put forth the same effort in making a choice when the outcome does not affect them. It is basically the difference between window shopping and making actual purchases. Because the respondent does not actually pay the stated amount in a CV survey, there is no penalty for giving an answer different from the person’s true preferences.²⁵

²⁴ Hypothetical bias is not unique to CV studies, but can be found in other types of studies that rely on people’s intentions rather than their actual behaviors. Kemp and Maxwell’s (1993) review of marketing studies shows that stated intentions do not reflect actual purchases. Swait, Louviere, and Williams (1994) report that the hypothetical data can mispredict shipping company market shares by as much as 40 percent. Adamowicz, Louviere, and Williams (1994) demonstrate that anglers’ values for a fishing trip based on hypothetical data was two to eight times higher than values based on actual fishing trips. Desvousges, MacNair, and Smith (2000) reveal that hypothetical stated preference techniques imply anglers state that they are willing to drive 158 miles to avoid fishing at a site with a fish consumption advisory, compared to actual trip data where they only drive 18 miles to avoid the same type of advisories.

²⁵ Harrison (2007) reveals that about 40 percent of the respondents who took the *Exxon Valdez* CV survey believed that the survey was part of the damage assessment. The Stratus CV survey did not ask the respondents a similar question. However, to the extent that the Stratus respondents guessed that the survey results have a role in the Attorney General’s lawsuit, they may not have the proper motives to reveal their true WTP values.

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The NOAA Panel concurred on the issue of hypothetical bias leading to overestimates of damages by stating:

“The Panel is persuaded that hypothetical markets tend to overstate willingness-to-pay for private as well as public goods. The same bias must be expected to occur in contingent valuation studies” (Arrow, et al.1993, p. 4610).

In summary, hypothetical bias invalidates CV estimates of total value, which includes both use and nonuse values. Because respondents do not have the incentive to provide their true answers and do not bear the consequences of their responses, CV results are not economically sound when used in the manner proposed by Stratus and the plaintiffs.²⁶

4.3.1 The Stratus CV survey results demonstrate hypothetical bias.

Results of the Stratus CV study indicate that the respondents exhibit response patterns consistent with hypothetical bias. Most strikingly, more than one-third of the base version respondents did not pay state income taxes in 2007 (Table 6.19). Of these respondents, more than 58 percent of them voted for the alum treatments. When a full refund is also factored in, 258 respondents of the 647 respondents who voted for the alum treatments did not pay state income taxes. Thus, for more than one-third of the “for” respondents, the commitment of dollars was entirely hypothetical. They voted for the alum treatments without any commitment or belief that they would have to pay the cost of the alum treatments. Certainly, hypothetical bias permeates these CV results.

The Stratus CV Survey permits the evaluation of several respondent opinions and beliefs, which would be at odds with voting for the alum treatments. These inconsistencies in logic are evidence of hypothetical bias. These questions included the respondents’ beliefs and opinions that

- Decreasing water pollution in the State is not at all or only slightly important
- Decreasing state income taxes is very or extremely important

²⁶ Appendix A contains a detailed review of literature on hypothetical bias.

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- A lot less State tax money should be spent on the environment
- The algae conditions in **both** the lake and river are not at all or only slightly serious
- **Both** the lake and river will naturally recover faster than what the interviewer indicated
- The alum treatments will not work well at all, or only slightly well
- The tax would be higher than that indicated by the interviewer
- University scientists cannot be believed at all, or only a little
- State government officials cannot be believed at all, or only a little
- They do not consider themselves to be environmentalists at all
- The extra tax amount would be extremely or very difficult for their households to pay

These data reveal that about 84 percent of the respondents who voted for the program in the base version of the survey demonstrate at least one of these inconsistencies in logic. More than 50 percent demonstrate at least two inconsistencies, and 23 percent of them demonstrate at least 3 inconsistencies. Table 4.4 contains the details.

Table 4.4: Inconsistencies in Respondents' Answers

Category	Base Version Respondents Who Voted For	
	Number of Respondents	Percent of Respondents
Decreasing State Income Taxes is Important	366	57%
State government officials cannot be believed	221	34%
The tax amount will be higher	173	27%
The lake and river will naturally recover faster	110	17%
The extra tax will be difficult to pay	77	12%
University scientists cannot be believed	48	7%
Not at all an environmentalist	42	6%
The algae conditions are not serious	28	4%

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Category	Base Version Respondents Who Voted For	
	Number of Respondents	Percent of Respondents
The alum treatments will not work	28	4%
Decreasing Water Pollution is Not Important	20	3%
A Lot Less Should Be Spent on the Environment	4	1%
TOTAL	544	84%
Number inconsistent in 5 or more aspects	18	3%
Number inconsistent in 4 aspects	51	8%
Number inconsistent in 3 aspects	82	13%
Number inconsistent in 2 aspects	177	27%

To the extent that these statements represent the true beliefs of the respondents, it is illogical that they would, in reality, agree to pay for such a program. If respondents did not believe that the alum treatment will work, why did they vote for the program? If respondents believed that the river and lake will naturally recover faster than what was indicated by the interviewer, why did they vote for the program? If respondents believed that the algae effects are not at all serious, why did they vote for the program? If respondents believed that it will be extremely difficult to pay the tax increase, why did they vote for the program? The logical conclusion is that these respondents agreed to pay because they knew that their agreements were in no way binding, that their votes were hypothetical.²⁷

4.3.2 The referendum approach does not eliminate hypothetical bias.

The NOAA Panel's guideline for the referendum format assumes that the survey respondents will behave as they would in a real referendum. Many economists have noted that the validity of this assumption remains an open empirical question (Diamond and Hausman 1994; Fisher 1996; Green, et al. 1998; Schläpfer and Brauer 2007; Harrison 2007). Thus, it is simply conjecture to argue that the results of the Stratus

²⁷ See Section 5 for an analysis of how WTP varies based on these inconsistencies in logic.

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study would mimic those of a real referendum because respondents in the Stratus study do not bear the consequences of their votes like they would in a real referendum. In fact, there is no compelling empirical evidence demonstrating that the hypothetical referendum format **eliminates** hypothetical bias.²⁸ On the contrary, there are many fundamental differences between a hypothetical CV question and a real referendum (Desvousges, Hudson, and Ruby 1996), indicating that hypothetical questions continue to be a problem. These differences include:

- Respondents are not required to pay the CV amount, but voters do pay for policies passed in a referendum. Therefore, the people who ultimately bear the consequences of the outcome are very different. Responsible parties bear the consequences in a CV damage assessment, and the voters bear the consequences in a referendum. Thus, in a real referendum the voters face the cost of making a mistake.
- In a CV referendum, respondents do not have to make any effort to cast their ballot, merely answer, “yes or no” to the interviewer’s question. In a real referendum, voters have to make the effort to go to the polls to vote, which reflects that the issue was important enough to them to make the effort.
- In an actual referendum, the voters have a chance to confer with others whose opinions they value before casting their votes (Schlöpfer 2008). The ability to air various arguments signals a very different process when compared to a hypothetical CV referendum (Horowitz 2000).
- In a CV referendum, respondents have to make up their minds on the spot during the survey interview. In a real referendum, voters have ample time to think about an issue before they cast their ballot. Voters in actual elections go to the polls knowing that they will cast a vote. When respondents first agree to participate in a hypothetical CV referendum, they do not necessarily know, at the beginning of the process, that they will be expected to “vote.” Vossler and Kerkvliet (2003) identify this element of surprise for CV respondents in a hypothetical referendum as a key difference between actual votes and hypothetical ones. (See also Horowitz 2000).
- The access to information is controlled by the survey designer in a CV survey while voters have the opportunity to obtain as much or as little

²⁸ Hypothetical referenda may not even be good predictors of actual referenda. Diamond and Hausman (1993) argue that the referendum approach “...has no foundation in individual economic preferences” because respondents react to the amount of information they have and the context of the situation (Diamond and Hausman 1993, p. 17). They discuss an example of the inaccuracy of opinion polls on environmental issues in California (“Big Green” Proposition 128). Two opinion polls conducted by the Los Angeles Times found that 55 percent of respondents who had an opinion (84 percent of those polled) would vote in favor of the proposition. However, Proposition 128 was supported by only 36 percent of voters in the actual election. See Diamond and Hausman (1993) for additional details on how surveys were poor predictors of 36 actual election outcomes.

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information as they desire in a referendum, including alternative viewpoints. In this case, the survey presented only the State's viewpoint on the matter and did not represent the viewpoint of the poultry industry, or others. It did not highlight any of the economic trade-offs that the alum treatments would impose on other farmers and ranchers, such as cattle-grazing impacts.

- In a CV referendum, respondents have to answer out loud to an interviewer. In a real referendum, voters cast their ballot in the privacy and secrecy of the voting booth. In the Stratus CV survey, not only did the respondents have to state their votes verbally to the interviewer, but in the case of approximately 30 percent of the favorable votes, other adults were present during the interview (Table D.66). The lack of privacy during a CV vote may result in an upward bias of votes "for" because the respondents may try to please the interviewer (Tourangeau, Rips, and Rasinski 2000) or may want to appear more socially responsible (Vossler, et al. 2003; Ethier, et al. 2000). Kanninen (1995) reveals that 20 percent of CV respondents may be "yea-sayers." Harrison (2007) reveals the results of a "ballot box" study where one-half of the in-person survey respondents were allowed to cast their votes on paper, without revealing them to the interviewer. The results indicate a much lower percentage of "for" votes when respondents did not have to reveal their votes verbally to the interviewer.
- In an actual referendum, the results refer to the percentage of the votes for the program, based on a pre-determined cost. In a hypothetical CV referendum, the results depend on subsequent statistical manipulations to arrive at society's purported value for the resources described. Many judgments and assumptions underlie the hypothetical survey results, while in actual elections, the election officials make no judgments or assumptions in order to determine the results.
- The multiple, fictitious dollar amounts offered in a CV question are not the actual cost of providing the public good, but are tools of the survey designer. "Estimating mean WTP requires the researcher to vary the policy's stated cost across the respondents and then calculate the implied distribution of WTP. In this case, one of two problems arise. Either the researchers must lie about the policy's costs to the respondents *or* the costs must be randomly distributed across the population" (Horowitz 2000). The evidence suggests that people anchor on those values.
- The goal of a damage assessment is to determine a specific dollar value of forgone services while the goal of a referendum is to determine whether or not some program should be adopted. The damage assessment goal requires a higher degree of precision because the absolute magnitude of the estimate is crucial.

Therefore, the argument that using a mock referendum eliminates the problem of hypothetical bias is without foundation.

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Clearly, other important differences exist between the Stratus hypothetical referendum vote and those in a real referendum. For example, the first difference, and probably the most obvious, is that the interviewers showed up on their doorsteps to record their votes. Thus, respondents did not have to exert the effort to vote for the referendum as they would have to in a real referendum. Early in the survey process, respondents are told that the interviewers are on their doorsteps because the State wants to find out if people are willing to pay for a new State program. When asked whether or not they had previously been interviewed “like this” to get their opinion about whether the State should spend tax money on a new program, 98 percent of the respondents indicated that this had never happened to them before (Table D.13). From the very beginning, respondents know that this is not a normal way for a governing body to solicit public opinion. The normal ways include issuing written responses for comments, conducting public hearings and town-hall meetings, and even conducting opinion polls by telephone. Showing up on the doorstep is practically unheard of.

Moreover, the potential respondents were pursued for their opinions. There were “sorry I missed you” cards left in the door when respondents were not home. There were advance letters and refusal conversion letters in the mail. There were even refusal conversion phone calls from university professors in Maryland and California. One of the people who refused to complete the interview is quoted as saying “over and over, I’m not interested.” Another refusal indicated that his wife is pregnant and they have kids and their home life is not conducive to completing a survey. The list of refusal follow-ups clearly indicates a vigorous pursuit of respondents to complete the interview (Bishop Corr 0000126). Government agencies seeking public input on tax spending matters rarely pursue public opinion with such vigor. Not only were the respondents pursued, but they were paid as well.²⁹ In normal public opinion matters, respondents give their opinions freely. For all of these reasons, the setting for the voting event, from the respondents’ viewpoint, was not comparable to a normal referendum.

²⁹ Apparently, some respondents were paid \$20 and some were paid \$50 to try to get the more reluctant respondents to complete the survey (Appendix C of the Stratus CV report).

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Another critical difference between a real referendum and the Stratus CV study is that respondents did not have a not-vote option. Certainly, in actual elections and referenda, voters may choose to not vote. Presumably, if some voters do not care about the outcome in an actual referendum, they may not bother to vote. In this study, the respondents did not have that choice. Stratus made a conscious decision to not allow a no-vote option, despite the NOAA's Panel recommendation that it be included. Specifically, the NOAA Panel included this recommendation to identify respondents who were indifferent, who needed more time or information before they could credibly vote, who preferred another mechanism, who were bored, or who wanted the survey to end. When the no-vote option is included in a referendum CV survey, the percentage of respondents who choose it ranges from 9 percent (Carson, et al. 1994) to 30 percent (Whittington, et al. 1994). As Section 4.3.1 above demonstrates, both the inclusion of and the treatment of undecided votes often changes the results of the hypothetical CV referendum.

One of the reasons that researchers do not include a no-vote option is that it will reduce the sample size on which WTP estimates are generated. While such a concern may be valid for academic study with limited funding, that restriction does not apply to the Stratus CV survey. Clearly, the Stratus researchers had ample funding to implement a survey with a large sample size.³⁰ Instead, Stratus cites recent research (conducted by members of its team) that it finds sufficiently compelling to disregard the NOAA Panel's recommendation. However, Harrison (2007) provides a discussion of how the results of this research "are very sensitive to how one interprets responses" (p. 94).

When disregarding the NOAA Panel's guideline, Stratus concludes that CV surveys which are "designed very carefully to use language that is clearly understandable to respondents" need not include a no-answer option (p. 3-18). Whether or not the respondents clearly understood the Stratus CV survey is highly debatable because the survey's results reveal that some respondents did not understand the survey (see Section 4.2 and Table 4.3 above). These results include

³⁰ However, passing the scope test appears to be an artifact of the large sample size. See Section 5 for a discussion.

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confusion about the role of the litter-spreading ban, confusion about the amount of taxes that would be paid, and confusion about which rivers and lakes that tax monies and alum treatments would be applied to. The claim of having a questionnaire that is clearly understood by the respondents is an inadequate basis for rejecting the NOAA panel recommendation on the no-vote option.

Stratus also asserts that the consequentiality of the mock referendum eliminates the hypothetical bias. In essence, consequentiality refers to the realism of the survey, from the viewpoint of the respondents. A careful review of the realism aspects of this survey reveals that the Stratus CV survey is not consequential. As previously discussed, at least some respondents were impatient, distracted, inattentive, and did not take the survey seriously. The foregoing discussion has also highlighted the many ways that this mock referendum differs from a real referendum.

For consequentiality to hold, Carson and Groves (2007) also add that the respondent must believe that the government agency can compel them to pay (p. 188). However, the ability of the government agency to compel them to pay is not realistic for many respondents. Recall that the alum treatments will be funded through State income taxes. As previously described above in Section 4.3.1, many respondents who took the base version of the survey and voted for the program do not pay State income taxes. Certainly, more than one-third of the respondents knew that the State would not be able to extract payment from them. For all of the reasons discussed in this section, the Stratus CV Survey lacks consequentiality. Even if, for the sake of argument, one believed that the referendum approach eliminates hypothetical bias, this CV survey deviates too much from an actual referendum to do so.

4.3.3 The certainty question does not eliminate hypothetical bias.

One of the reasons that Dr. Bishop, one of the authors of the Stratus report, does not believe that hypothetical bias is relevant to the Stratus CV results is the use of the certainty question (Bishop undated, Bishop0001271)³¹. During the interview, shortly after the vote question, respondents are asked how sure they are of their vote. Potential responses range from “extremely sure” to “not at all sure,” with five graduated

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categories for the respondent's answer. This question is known as the certainty question. The typical adjustment to WTP recodes the less certain "for" votes as "against" votes. When Stratus makes this adjustment to their results, the average WTP falls from \$184.55 to \$178.08 (Table G.2), which they conclude is not a significant difference.³²

In the literature cited by Dr. Bishop (undated), he describes several empirical studies where the use of a certainty question purportedly eliminates hypothetical bias:

- Blumenschein, et al. (1998) asked respondents whether they would (hypothetically) pay a given price for sunglasses. For those who responded affirmatively, the next question asked whether they were "definitely sure" or "probably sure" of their decision. The "probably sure" respondents were recoded to "no."
- Champ, et al. (1997) used a 10-point scale, where 10 represented "very certain" and 1 represented "very uncertain." Champ, et al. (1997) re-coded all of the "yes" responses with scores on the certainty scale other than 10 to be "no."
- Champ and Bishop (2001) used the same 10-point scale. They re-coded "yes" to "no" for all certainty scores below 8.
- Poe, et al. (2002) used the same 10-point scale. They re-coded "yes" to "no" for all certainty scores below 7.

What is noticeably different from the certainty adjustments in these four studies and the certainty adjustment in Stratus report is the extent of re-coding. In two of the four studies, only the most certain respondents' answers were not re-coded while any expression of uncertainty was re-coded. In the other two studies, "yes" responses in either the lowest 60 percent or the lowest 70 percent of the certainty scale were re-coded. In Champ and Bishop (2001), for example, the recoding resulted in almost 50 percent of the "yes" votes being re-coded to "no" votes. Only with that substantial adjustment did the hypothetical results reflect the actual results.

To be comparable to the adjustments made in these four certainty studies, Stratus should, at a minimum, re-code the "for" votes in the "moderately sure" category.

³¹ Dr. Bishop wrote some thoughts or musings on hypothetical bias in CV in an undated paper.

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More than 20 percent of the respondents who took the base version of the survey fall into this category, and more than 64 percent of them voted for the alum treatments (Table 6.31). Mimicking the more appropriate re-coding protocols in the studies cited above would substantially lower the WTP result.³³ Accordingly, the certainty adjustment as applied in this CV study has not eliminated hypothetical bias.³⁴

4.4 The WTP estimates cannot be validated, rendering the results unreliable.

External validity³⁵ requires that a CV survey be capable of producing “true” WTP values for a specific commodity. External validation involves comparing values produced by CV to some objective value that has been calibrated for a high degree of accuracy. For example, Greenwich Mean Time provides a standard for evaluating the accuracy of a time clock. The time measured by a clock can be externally validated by the Greenwich atomic clock.

External validation is an important part of any scientific research because it allows the researcher to evaluate the plausibility of data, assumptions, and any model predictions. Such validation is particularly crucial for a damage assessment because claims are required to be reduced to a “sum certain.” (51 *Fed. Reg.* 27751, 1986.)

Total values, comprised of both use and nonuse values, cannot be externally validated because no standard and independent measure exists for comparison. Use values can potentially be validated though revealed preference techniques (observing

³² Had the Stratus team used the “certainty adjusted” WTP estimate for damages, the amount would be lower by almost \$9 million.

³³ See Section 5 for details.

³⁴ Bishop (undated) also refers to the use of “cheap talk” as another mechanism for eliminating hypothetical bias. Cheap talk as used by CV practitioners and by experimental economists refers to explicit language in a CV questionnaire that defines hypothetical bias for the respondent, emphasizes that the vote in this survey is hypothetical, but asks the respondent to vote as if it were real. There are various gradations of cheap talk, with “heavy” cheap talk being more explicit in terms of defining hypothetical bias and emphasizing the hypothetical nature of the survey. According to Dr. Bishop, “light” cheap talk produces mixed results with respect to hypothetical bias but “heavy” cheap talk “solves the problem of hypothetical bias. Dr. Bishop notes that Stratus did not employ a heavy cheap talk strategy because “[a] contingent valuation survey cannot be consequential if it states in no uncertain terms that the whole exercise is hypothetical” (p. 17). This presents a conundrum. Heavy cheap talk allegedly eliminates hypothetical bias but it also eliminates consequentiality, the presence of which also purportedly eliminates hypothetical bias.

³⁵ External validity is also commonly referred to as *criterion validity*.

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recreator behaviors). In contrast, nonuse values are not associated with an observable behavior and cannot be measured using a revealed preference technique or market prices. Because nonuse values are a component of total value, a revealed-preference technique cannot be used to determine total value either. CV total values cannot be externally validated because of the absence of alternative estimation methods, such as market-place transactions or revealed-preference techniques, which can directly confirm or refute total values.

Other economists recognize the lack of a “true” value to compare with contingent-valuation total values. For example, Freeman (1993) states that “[i]deally, one would like to assess the validity of a hypothetical value by comparing it with the true value. But the true value is usually not known, so this option is not available” (p. 176). Similarly, Smith (1986) states that “the only standard available from current research is itself an estimate of the unknown ‘true’ value of an individual’s valuation” (p. 174).

4.4.1 The Stratus scope test is not meaningful

A scope test is an essential part of a CV study. The test consists of administering two versions of a survey questionnaire to two samples of respondents. The questionnaire versions are identical in everything but the magnitude of the environmental injury. In other words, the injury described in the scope version (“scope survey”) will be smaller in magnitude than the injury described in the main version (“base survey”). Respondents are randomly assigned to one version so that the respondents groups across the two versions are as identical as practical.

CV studies suffer from an “embedding” effect: it has been observed that WTP to mitigate an environmental problem affecting a large area is not very different from WTP to address the same problem in a small subpart of that area (Kahneman and Knetsch 1992). It has also been observed that WTP differs little based on the amount of a particular wildlife species that will be conserved (Desvousges, et al. 1993; Arrow, et al. 1993). These results are at odds with basic economic principles that dictate WTP to resolve a larger scale problem should be greater than for a smaller scale problem.

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The best explanation for this phenomenon is that respondents did not actually report the economic value of the good they were asked about, but rather were deriving “moral satisfaction” (Kahneman and Knetsch 1992) from being able to contribute to the mitigation of the problem and being known to do so. As this “moral satisfaction” (or “warm glow”) remains relatively consistent despite the scale of the environmental problem, the reported WTP will also be similar.

The problem presented by these “moral satisfaction” or “warm glow” findings led to the following statement in the NOAA Blue Ribbon Panel Report (Arrow, et al. 1993, p. 37):

“Specifically, if a CV survey suffered from any of the following maladies, we would judge its findings ‘unreliable’: [...] -- Inadequate responsiveness to the scope of the environmental insult.”

As a result, determining whether the responses were unreliable because they are inadequately responsive to changes in the scope of an environmental problem has become a requirement for properly conducted CV studies used in NRDA cases. The members of the NOAA panel (Arrow, et al. 1994) later clarified what they meant by “inadequate:”

“The report of the NOAA panel calls for survey results that are ‘adequately’ responsive to the scope of the environmental insult... Had the panel thought that something as straightforward as statistical measurability were the proper way to define sensitivity, then we would (or should) have opted for language to that effect. A better word than ‘adequate’ would have been ‘plausible’: A survey instrument is judged unreliable if it yields estimates which are implausibly unresponsive to the scope of the insult. This, of course, is a judgment call, and cannot be tested in a context-free manner, as would be the case if the proposed scope test were implemented.

These two definitions will not generally yield the same conclusions.

There will be settings in which estimates made with plentiful observations are ‘statistically’ sensitive to the scope but at the same time are ‘implausible’ [sic] insensitive. Also, if the sample size is small and the scope difference minor, the estimates may be ‘statistically’ insensitive to the scope, yet ‘plausibly’ sensitive.

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The fundamental problem with any purely statistical sensitivity is that it depends (foolishly) on the sample size.

In small samples, no effects are 'statistically significant.' In large samples, everything is 'statistically significant.' What this means is that the proposed scope test can probably be passed if the trustees are willing to pay a high enough cost. But the willingness to bear this cost has no obvious implications for the 'reliability' of the results."

The authors of the Stratus Report re-characterize the NOAA Guidelines by stating: "The Panel was referring to the expectation, based on economic theory, that WTP to achieve a **larger environmental improvement** should be larger than WTP to avoid a smaller one [emphasis added]."³⁶ This unusual interpretation leads the authors to simultaneously distinguish the base scenario (designed to be valued) from the scope scenario (which is used to test it), across more than one dimension: both geographic scope and effectiveness of the proposed treatment. A proper scope test should distinguish only one dimension: "either in a quality or quantity sense" (Carson, Flores, and Meade 2001, p. 181).

The distinctions between the base survey and scope survey scenarios in the Stratus Report illustrate the multi-dimensional differences in their coverage:³⁷

- a. In the scope scenario, the target of the alum treatments is restricted to the lake and does not include the river. The scope version of the questionnaire indicates that the river would recover naturally in 10 years. There is no mention of trucks to spread alum on the land and dispensers in the river.
- b. In the scope scenario, phosphorus levels in the river would return to 1960 conditions 10 years following the ban without any treatment, whereas, in the base scenario, those levels recover in 50 years without any treatment, or 10 years with the alum treatment.
- c. The base survey states that the lake will recover in 20 years with alum treatments, whereas the scope survey lengthens that period to 50 years. This enlargement of 30 years required for recovery runs directly contrary to the purpose of the Scope Survey, which is to **reduce** the scope of the problem and determine whether respondents scale their WTP accordingly.

³⁶ Emphasis Added, Stratus Report, Vol. I, p. 3-17.

³⁷ The differences between the texts of the two surveys are highlighted in Appendix B.

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Although the injury described in the scope survey is smaller than the base survey in terms of geography (a and b above), it is larger in its persistence over time (c above). Further, contrary to the NOAA guidelines that call for a “high standard of richness in context to achieve a realistic background,”³⁸ the Stratus report does not tell respondents the exact size of the area that is described in each of the questionnaires. Item (c) incorporates differences in both persistence of the articulated problem and the effectiveness of treatment with alum. Respondents likely perceive 50 years with alum treatment as a comparatively small improvement when compared with the 20 years described in the base instrument for recovery with alum. It is not clear why there should be a difference in the effectiveness of alum treatments between the two scenarios.

By diverging from the base scenario along multiple dimensions it is virtually assured that respondents will view the two scopes differently but not in a manner that can be used to test whether WTP is appropriately sensitive. The differences in valuation are not just due to a “smaller injury,” but also to perceived differences in the effectiveness of treatment. Accordingly, this scope test cannot be used to affirm the WTP contained in the Stratus Report.

The literature on CV recognizes that problems in survey design can also result in failure to pass a scope test (Carson, Flores, and Meade 2001, p. 181). Among these problems are “...questions where the underlying metric on which respondents perceive the *larger* good is different from that on which respondents perceived the *smaller* good, and...differences in the perceived probability of the different goods actually being provided” (Carson, Flores, and Meade 2001, p. 200). In other words, if respondents think the proposed environmental solution in the scope survey is more or less likely to work than the one described in the base survey, this will lead to differences in their responses. Similarly, where respondents view two different environmental resources (e.g., a river and a lake) as having different uses or values, this may result in a different WTP for restoration. In either of these examples, the differences perceived by respondents between the two survey versions will influence the results, which can no longer properly be used to satisfy the scope test.

³⁸ NOAA report, p. 28

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A number of studies have criticized precisely this type of error or noted the need to isolate a single dimension of relative injury in the design of any scope test. Among these are Smith and Osborne (1996), in which a meta-analysis was conducted to answer the scope question, using different CV studies that measure WTP for visibility in parks. The study compared sensitivity to scope only on one dimension – relative visibility. Similarly, Carson (1997) noted: “The oil spill experiment is marred by the fact that the larger good invoked a different (and lower) probability of success of preventing a large spill than had been used in the second treatment, thereby providing a significant confounding factor.” This is precisely the type of confounding factor present in the Stratus surveys.

The authors of the Stratus Report mention that 58.4% of respondents to the base survey voted “for” the proposed cleanup program.³⁹ They fail to report the same measure for the scope survey: which is 42.5% in favor. This result may be driven by the fact that respondents had less faith in the effectiveness of the remediation scenario described in the scope survey and not just the smaller magnitude of the described injury. The authors provide no analysis of how to unravel these two confounding influences.

Average WTP derived from the base survey is \$184.55, leading to an aggregate WTP of \$249,673,635.⁴⁰ By contrast, average WTP under the scope survey is \$138.51, leading to aggregate WTP of \$187,387,131.⁴¹ This reduction in WTP is only 25%, a surprisingly small change in response to what is supposed to be a significantly smaller environmental damage.⁴² To put this into perspective, the difference between the base and scope WTP in a 1994 CV study, whose authors include Stratus team members Hanemann and Krosnick, was nearly twice that of the Stratus study at

³⁹ Stratus Report, Vol. I, p. 6-2.

⁴⁰ $\$184.55 \times 1,352,878 = \$249,673,635$.

⁴¹ $\$138.51 \times 1,352,878 = \$187,387,131$.

⁴² The scope WTP is about 75 percent of the base WTP. If one believed the WTP results from the Status CV study, then Oklahoma residents are willing to pay \$138 dollars to accelerate restoration of Lake Tenkiller from 60 years to 50 years. But they are willing to pay less than \$46 (\$184 minus \$138) to accelerate restoration in the Illinois River by 40 years, and achieve faster recovery of the lake, relative to the scope version. This illogical conclusion is the result of inappropriate survey design.

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47%.⁴³ The Court ultimately rejected that study of damages from PCB and DDT contamination, apparently because “the descriptions of alleged ‘injuries’ to fish and birds used in the survey were unsupported by the trustees’ own evidence and experts.”⁴⁴ As previously discussed, the same problem exists with the Stratus survey due to misleading, incomplete and arguably inaccurate factual statements about algae and its impact on fish populations as well as the benign effects of alum treatments.

Information about the reasons respondents provided for voting “for” or “against” the referendum question also fail to assist in resolving this confusion between the base and scope scenarios. Tables 6.28 and 6.30 of the Stratus report list reasons respondents supplied for voting for or against the referendum question in the scope survey. The authors assert that “the reasons... for voting ‘for’ and ‘against’ the program... closely resemble the reasons given by the base respondents” (page 6-31). However, if we closely compare the corresponding tables for the base survey (Table 6.2 and Table 6.3), a number of important differences are apparent. All four tables (two pertaining to the base survey and two pertaining to the scope survey) bear a notation that the percentages they list may not total to 100 percent, because respondents could have supplied more than one reason for their votes. However, the base survey responses total 122.2 percent (reasons for “Yes” votes) and 132.8 percent (reasons for “No” votes), while the scope survey reasons total precisely 100 percent (“Yes” reasons) and 100.6 percent (“No” reasons). This suggests that respondents were differently encouraged to complete and fully respond to the two surveys.

Leaving aside this problem of number of reasons supplied per respondent, those voting “Yes” in the base survey appear to have been more convinced of the efficacy of the proposed restoration than were those who voted “Yes” in the scope survey referendum. Nearly 40 percent of those who voted “Yes” in the former group said the program would help the area around the lake, while only 34.1 percent of those in the latter group offered the same explanation. Similarly, 20.6 percent of those voting

⁴³ Carson, Richard T., W. Michael Hanemann, Raymond J. Kopp, Jon A. Krosnick, Robert C. Mitchell, Stanley Presser, Paul A. Ruud, and V. Kerry Smith. 1994. “Prospective Interim Lost Use Value Due to PCB and DDT Contamination in the Southern California Bight” (Report to National Oceanic and Atmospheric Administration): p. 253.

⁴⁴ Court Rejects Contingent Valuation Study in Montrose Case. (June 2000). Sidley & Austin Environmental Advisory.

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yes in the base survey said the program would speed up recovery, while only 15.9 percent of those voting yes to the scope survey provided this same response. These differences between favorable votes in the base and scope survey are detailed in Table 4.5.

Table 4.5: Comparison of Base and Scope Reasons for Voting “For”

Base Survey Responses	%	Scope Survey Responses	%
1. Program will help area around river and lake	39.6%	1. Program will help area around river and lake	34.1%
2. Program will benefit others	22.2%	2. Program will benefit others	16.6%
3. Program will speed up the recovery	20.6%	3. Program will speed up the recovery	15.9%
4. Program will bring lake back to earlier state	11.5%	4. Other	7.8%
5. Other	9.0%	5. Program will bring lake back to earlier state	6.8%
6. Program reduces risk to human health	4.7%	6. Program reduces risk to human health	5.1%
7. Respondent would benefit from program	4.2%	7. Program will protect environment in general	4.7%
8. Program will protect environment in general	4.2%	8. Respondent would benefit from program	3.7%
9. Respondent is concerned about environment	2.6%	9. Respondent is concerned about environment	2.7%
10. Program has other benefits than cleaning water	2.3%	10. Society is responsible for fixing problem	1.0%
11. Society is responsible for fixing problem	0.9%	11. Program has other benefits than cleaning water	1.0%
12. Others in household concerned about environment	0.2%	12. Others in household concerned about environment	0.3%
13. Don't know/ Doesn't remember	0.2%	13. Blank response	0.3%
Total	122.2%	Total	100%

These differences are more pronounced when comparing the reasons for voting “No” on the referendum as described in Tables 6.3 and 6.28 of the Stratus Report. The most common reason for voting “No” in the base survey was that the “cost is too high for respondent household” (18 percent) but this was only the fifth most common response for those voting the same way on the scope survey (8.3 percent). Conversely, for those voting “No” to the scope survey, the fourth most common explanation was that the “benefits are not worth the cost” (8.5 percent) but this was one of the least frequent explanations offered by those who voted “No” to the base survey

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(only 2.4 percent, the 17th most commonly offered response). This once again suggests that, by mingling different timelines and natural recovery periods with the difference in geographic dimension of the two surveys, Stratus left respondents with two very different perceptions about the cost effectiveness of the two programs. This violates the very purpose of a scope survey. Consistent with this observation, by far the most common reason for voting “No” to the scope survey was that the “program does not do enough” (18.5 percent), while this same reason (together with “users should pay”) ranked last in explaining “No” votes to the base survey (1.2 percent). This dramatic difference validates our concern that the scope survey proposed a less effective restoration program when compared with the natural recovery alternative than did the base survey. The comparison of all reasons offered for voting “No” to the two surveys appears in Table 4.6.

Table 4.6: Comparison of Base and Scope Reasons for Voting “Against” the Tax

Base Survey Responses	%	Scope Survey Responses	%
1. Cost is too high for respondent/household	18.0%	1. Program does not do enough	18.5%
2. Other issues are more important	15.1%	2. Let nature solve the problem	12.0%
3. Let nature solve the problem	13.2%	3. Other issues are more important	11.8%
4. Does not want to pay more taxes	9.6%	4. Benefits are not worth cost	8.5%
5. Cost of program is too high	9.4%	5. Cost is too high for Respondent/Household	8.3%
6. Other	8.6%	6. Cost of program is too high	6.5%
7. Not sure if the program would work	7.4%	7. Other	5.3%
8. Cost too high for others	6.5%	8. Does not care about the problem	4.8%
9. Program only helps a few rivers and/or lakes	6.2%	9. Problem could/should be solved other ways	3.8%
10. Treatments could have unknown bad effects	6.0%	10. Program only helps a few rivers and/or lakes	3.5%
11. Does not care about the problem	5.8%	11. Does not want to pay more taxes	3.3%
12. Does not like way payment would be collected	5.0%	12. Polluters should pay	2.8%
13. Problem could/should be solved other ways	4.6%	13. Cost too high for others	2.5%
14. Polluters should pay	3.6%	14. Treatments could have unknown bad effects	2.3%
15. Someone else should pay	2.9%	15. Not sure if the program would work	1.8%

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Base Survey Responses	%	Scope Survey Responses	%
16. Money might be used for other purposes	2.4%	16. Someone else should pay	1.5%
17. Benefits are not worth cost	2.4%	17. Does not like way payment would be collected	1.0%
18. People not near lake won't want to pay	1.9%	18. Money might be used for other purposes	1.0%
19. Does not trust government	1.4%	19. Users should pay	0.5%
20. Program does not do enough	1.2%	20. Program would be done for other rivers/lakes	0.3%
21. Users should pay	1.2%	21. Does not trust government	0.3%
22. Don't know/ Doesn't remember	0.2%	22. Don't know/ Doesn't remember	0.3%
23. Refused	0.2%		
Total	132.8%	Total	100.6%

Finally, the sample size used for the base survey is approximately twice that of the scope version. The larger sample size inherently produces a smaller standard error, which translates to a smaller confidence interval for the results of the base survey. Had the base survey sample been as small as the scope survey sample, the results of the base survey would likely have had a larger standard error. Because WTP estimated from the two surveys is separated by only \$3 (the difference between the upper-end of the scope WTP and the lower-end of the base WTP), a larger standard error would likely have resulted in overlapping confidence intervals. With overlapping confidence intervals, Stratus would not have been able to declare that the WTP values for the base version and the scope version are significantly different. This means that the CV would have failed the essential scope test.

A large enough sample size can make any difference statistically significant. To quantify the effect of sample size upon statistical significance in Stratus' WTP estimates, we employ a bootstrap technique for the base dataset. The goal of a bootstrap is to generate a distribution of estimates based on different samples from the base data. Instead of calculating WTP from the entire base dataset of 1,093 observations, we calculate WTP from 544 observations randomly drawn from that base data. Since the scope data consist of 544 observations, this procedure generates a hypothetical dataset of bids and responses to the base scenario that is the same size as the scope data. Not surprisingly, using comparable sample sizes alters Stratus'

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claimed statistical significance of differences in WTP between the base and scope surveys.

Applying the traditional bootstrap procedure, the base survey yields a 95% confidence interval of WTP between \$162.32 and \$206.77, a range \$6.79 wider than that derived using the entire base dataset (\$165.72 to \$203.38).⁴⁵ The new base WTP using this smaller sample size thus overlaps WTP estimated from the scope survey using a traditional bootstrap, which was \$112.69 to \$164.32, also measured at a 95% confidence interval using 544 observations.⁴⁶ This overlap of confidence intervals indicates that Stratus' selection of sample size may be driving the statistical significance it claims to identify between the base and scope WTP.

Table 4.7 reports a simulation to help illustrate this point. The first two rows contain the results reported by Stratus. Notice that the standard error (se) for the scope version is almost 30 percent higher than is the standard error for the base version. To simulate how a sample size equal to that of the scope version would change the confidence interval of the base version, the third row shows the estimated se and confidence interval for the re-estimated base survey using a traditional bootstrap. In order to compare the base survey with the smaller sample size to the scope survey, the se and confidence interval estimated using a traditional bootstrap is shown in the fourth row. This re-estimation shows that the confidence intervals now overlap. The lower end of the base version is \$162.32, which is smaller than the upper end of the scope version, \$164.32 and thus they overlap by \$2. With a larger standard error, the WTP results are no longer statistically different and the scope survey cannot be used to validate the results of the base survey as required by professional standards.

⁴⁵ A jackknife bootstrap cannot be used to estimate the base survey WTP using a smaller random sample because a jackknife bootstrap would proceed by repeatedly calculating WTP based on the given dataset, leaving out only one observation at a time. This non-random procedure cannot exclude more or less than one observation at a time, making it impossible to simulate a smaller dataset.

⁴⁶ Scope WTP was estimated using a traditional bootstrap because the confidence intervals generated by the traditional bootstrap differ from the 95% confidence intervals generated by the jackknife. This is because the jackknife bootstrap incorporates the survey weights when it draws observations for the bootstrap procedure.

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Table 4.7: Impact of Different Samples Sizes

Survey	Sample Size	Mean	se	Confidence Interval	
Base, Stratus (Jackknife Bootstrap)	Base (1,093)	\$184.55	9.61	\$165.72	\$203.38
Scope, Stratus (Jackknife Bootstrap)	Scope (544)	\$138.51	12.25	\$114.50	\$162.51
Base Version (Traditional bootstrap)	Scope (544)	\$184.55	11.34	\$162.32	\$206.77
Scope (Traditional Bootstrap)	Scope (544)	\$138.51	11.34	\$112.69	\$164.32

Some members of the NOAA Panel explicitly warned of this problem, cautioning against the use of sample size as a means to pass the scope test. “In large samples, everything is ‘statistically significant.’ What this means is that the proposed scope test can probably be passed if the trustees are willing to pay a high enough cost. But the willingness to bear this cost has no obvious implications for the ‘reliability’ of the results” (Arrow, et al. 1994). In other words, the difference that Stratus reports between the results of the base and scope surveys may largely be an artifact of sample size and do not provide the necessary indicia of reliability for the contingent valuation. This problem, compounded with errors in survey design that result in measuring fundamentally different assets, mean that the Stratus conclusions fail to cross the professionally imposed hurdle for scope validation, and therefore, the results of the Stratus study cannot be viewed as either valid or reliable.

4.4.2 The “construct validity” model does not validate the WTP estimate.

In an attempt to demonstrate validity in the WTP results, Stratus develops and reports a “construct validity” model (Table 6.26). This model explains the probability that a respondent voted for the alum treatments as a function of several of the other responses in the questionnaire. For example, the model indicates that the higher the bid amount, the less likely that the respondent would vote for the program. Similarly, the model indicates that if a respondent believed that the tax money would be used to clean up other rivers and lakes beyond the Illinois River watershed, then that respondent was more likely to vote for the program. If a respondent believed that natural recovery would occur faster than the interviewer said it would, then he/she was less likely to vote for the program. If respondents believed that the tax amount would

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be higher than that indicated by the interviewer, then they were less likely to vote for the program.

Although this model demonstrates that there are patterns in the hypothetical votes and the other answers in the survey, it does not adequately explain the hypothetical votes. Based on the pseudo- R^2 of 0.31 reported by Stratus, the model only accounts one-third of the variation of the base version votes. Although the model indicates that respondents who believed that natural recovery would occur faster were less likely to vote for the program, some of them still voted for the program. Although the model indicates that respondents who believed that the tax amount would be higher were less likely to vote for the program, some of them still voted for the program. Thus, the identification of these statistical relationships is not compelling. The model does nothing more than identify some weak patterns in the hypothetical data. Nor does any explanation of hypothetical data imply that these results would reflect the actual behaviors of the respondents.

Furthermore, the sensitivity assessment conducted by Stratus also fails to demonstrate that the CV results are valid. In general, the sensitivity analysis addresses two topics: how certain the respondent was of his/her vote and the extent that the respondent accepted the scenario described by the interviewer. To implement its sensitivity analysis, Stratus alters the respondents' answers to the vote certainty question (question 24) and the scenario acceptance questions (questions 27, 29-33).⁴⁷ They re-code the data so that all respondents were at least moderately certain of their votes and so that all respondents accepted the various elements of the scenario described. When the data are altered, the model does only a slightly better job of correctly predicting the hypothetical votes. With a pseudo- R^2 of 0.33, the adjusted model still only accounts for about one-third of the variation of the hypothetical votes. Even when Stratus assumes that the respondents were more certain of their votes and were completely accepting of the survey scenario, the model still fails to sufficiently explain the underlying motivations for the hypothetical votes. Moreover, it

⁴⁷ Incidentally, the sensitivity analysis excludes one question that also reveals the extent to which respondents accepted the scenario. Question 28 asked respondents whether they believed that phosphorus had caused the changes described, which reflects another dimension of scenario acceptance.

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fails to provide any convincing evidence that either the responses or the model conforms to what people would do if they were actually required to pay the stated increases in taxes.

A more logical and conservative sensitivity analysis would have changed respondents' hypothetical votes to be consistent with the certainty of their votes and their lack of scenario acceptance. For example, if a respondent voted for the program but then said that he was not at all certain of his vote, the sensitivity analysis could have changed his hypothetical vote to "against." If a respondent voted for the program but then said that she did not think that the alum treatments would work well at all, the sensitivity analysis could have changed her hypothetical vote to "against." As discussed below, implementing these changes results in dramatically different, and lower, WTP estimates, thereby further demonstrating the lack of reliability of the Stratus CV study.⁴⁸ For all of the reasons described in this section, the "construct validity" models fail to validate the WTP responses.

4.4.3 The error rate for this CV survey cannot be known.

One of the critical characteristics of reliability is whether the methodology has a known error rate. The error rate refers to the difference in the actual result and the statistical estimate. In this specific application, the error rate represents the difference between respondents' "true" values for a faster recovery of the Illinois River System and Tenkiller Lake and the results of the Stratus CV survey. Given that the total values addressed in the Stratus CV report include nonuse values, there is no way of knowing respondents' true values. Thus, an error rate for this survey cannot be estimated.

Moreover, the specific attempts made by Stratus at establishing validity for this survey have not been successful. The Stratus scope test is not meaningful. Moreover, the results do not conform to established economic principles, as indicated in the elasticity evaluation discussed below. Respondents admitted that they were valuing a much larger commodity when they voted, and the Stratus analysis failed to account for them. The Stratus validity model itself fails to sufficiently explain the determinants of the hypothetical votes. The respondents did not seriously consider their budget

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constraints when voting. For all of these reasons, an error rate for this CV survey cannot be estimated, further demonstrating the lack of reliability of the Stratus CV survey.

4.5 WTP values are artifacts of the bid design.

The WTP estimation approach used by Stratus relies on the proportion of respondents who voted “for” the restoration program at various tax payments, known as bid levels. The mean WTP represents a weighted average of the bids, with weights derived from the proportion of the sample voting for the program at each bid. Given this approach, the bid structure plays an important role in the calculation of WTP because the bids selected for the survey design affect the magnitude of WTP. This section describes the WTP’s sensitivity to the bid structure, especially to the highest bid offered. The arbitrary nature of the selected bids, which are selected by the plaintiffs’ experts, undermines the reliability of the estimated mean WTP.

Comparison of the results of the Stratus CV Study to other studies with different scopes of injury illustrates this point. Table 4.8 describes the key features of three other CV studies conducted as part of a damage assessment. These three studies are the *Exxon Valdez* study (Carson, et al. 1992), the Southern California Bight study (Carson, et al. 1994), and the California Oil Spill Study (COS) (Carson, et al. 1996). The latter two studies were developed to purportedly comply with the NOAA panel guidelines. These comparisons provide some evidence that CV values are artifacts of the bid design. Table 4.8 highlights the major features of each study, including the commodity, injury description, payment vehicle, location, and sampling frame. All three studies used a one-time tax-payment vehicle, minimizing any effect from payment terms across the studies.

⁴⁸ See Section 5 for further analysis.

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TABLE 4.8: COMPARISON OF MAJOR DESIGN FEATURES IN THE *Exxon Valdez*, Southern California Bight, AND California Oil Spill STUDIES

STUDY	<i>Exxon Valdez</i>	Southern California Bight	California Oil Spill
Commodity	<ul style="list-style-type: none"> • Program to prevent an <i>Exxon Valdez</i>-type spill along the South Central Alaskan coast sometime over the next ten years 	<ul style="list-style-type: none"> • Program to reduce the recovery period from 50 years to 5 years for four species affected by sediments contaminated with DDT and PCBs along the South Coast of California through covering of contaminated sediments. 	<ul style="list-style-type: none"> • Program to prevent harm from oil spills along California's Central Coast over the next ten years
Injury	<ul style="list-style-type: none"> • 1,000 miles of shoreline oiled (few years to recover) • 22,600 birds found dead—estimated total bird deaths of 75,000 to 150,000 (three to five years to recover) • 580 otters and 100 seals killed (couple of years to recover) 	<ul style="list-style-type: none"> • Each of the four species' (two fish and two endangered bird species) reproductive abilities have been affected by DDT and PCB contamination (five years to recover) 	<ul style="list-style-type: none"> • Many small animals and plants along ten miles of coastline (five years to recover) • 12,000 birds killed and 1,000 injured (ten years to recover)
Payment Vehicle	<ul style="list-style-type: none"> • One-time increase in federal income taxes; money sent to Prince William Sound Fund 	<ul style="list-style-type: none"> • One-time increase in state income tax; money would go to a special fund to cover the contaminated sediment 	<ul style="list-style-type: none"> • One-time increase in state income taxes; money goes toward setting up response centers
Sampling Frame	<ul style="list-style-type: none"> • U.S. residents 	<ul style="list-style-type: none"> • English-speaking households in California 	<ul style="list-style-type: none"> • English-speaking households in California

The *Exxon Valdez* study focused on a larger oil spill with more extensive injury to mammals and birds. Geographically, it covered 1,000 miles of shoreline. The restoration program would prevent similar oil spills for the next 10 years. The Southern California Bight study described injuries to two endangered species of birds along the southern coast of California. It shares a similarity with the Stratus CV survey in that the restoration program would accelerate recovery of the resources from 50 years to 5 years. The COS study described injuries to common bird species along the central coast of California. Its restoration program would prevent harm from oil spills for the next 10 years.

The Stratus CV survey described different restoration conditions in the base and scope versions. In the base version, the survey described that algae impacted about

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60 miles of the Illinois River and Tenkiller Lake, which is approximately 28 miles long. The survey noted that the Illinois River and several of its tributaries are designated as scenic rivers. The restoration program in the base survey would accelerate recovery from 50 years to 10 years for the river and from 60 years to 20 years for the lake. In the scope version, the restoration program would only affect the lake and would accelerate recovery by only 10 years (from 60 years to 50 years).

Table 4.9 compares the mean WTP values from the studies.⁴⁹ For the Stratus CV study, both the mean values for the scope and base version are included. What should drive the differences in per household WTP values is the relative size of the injury described. Thus, intuition suggests that the WTP value from the *Exxon Valdez* oil spill study, which arguably describes the most extensive injury of those in the table, should have the highest WTP value. However, the *Exxon Valdez* study has the lowest WTP value because it has the lowest bid structure. The top bid included in the *Exxon Valdez* study was \$120.

TABLE 4.9: Comparison of Mean Bids for CV Surveys

	<i>Exxon Valdez</i>	Southern California Bight	California Oil Spill	Stratus CV Survey
Number of Initial Bids Offered	4	5	5	6
Bid Range	(\$10 – \$120)	(\$10 – \$215)	(\$5 – \$220)	(\$10 – \$405)
Mean*	\$84.30	\$108.45	\$150.02	\$138.51 (scope) \$184.55 (base)

* Means for the first three are calculated using the Turnbull estimator. Mean from *Exxon Valdez* comes from Table E2-7 (Table 2) in Carson, et al. (1996) report. Southern California Bight mean comes from p. 195 in Carson, et al. (1994) report (Table 9.4). COS mean comes from p. 6-7 (Table 6.3) in Carson et al. (1996) report. Mean values are expressed in 2008 dollars for all four studies.

⁴⁹ Although the *Valdez*, California Bight, and COS studies used a different nonparametric estimator than does the Stratus Study, the general conclusions still hold. Section 5 of this report re-analyzes the Stratus data using the same nonparametric estimator used by the other studies. It also demonstrates that the Stratus pretest data, which reflect different (and lower) bid designs, confirms the impact on WTP from the bid design.

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In terms of the Stratus CV survey, its highest bid is almost twice as large as the highest bids California Bight and the COS studies and almost four times larger than the highest bid in the *Exxon Valdez* survey. The amount of the highest bid is what dominates the WTP values, not the differences in the injury described. The Stratus WTP result is more than two times the WTP from the Exxon Valdez survey, which is remarkable considering the differences in the described injuries. While it is possible that some of the difference is attributable to preferences changing over time and preferences differing among the households surveyed, the difference is too large to be explained by these other factors.

Suppose for the sake of argument, we use the interpretation of the scope design presented by Stratus, and ignore the differences in restoration efficiencies discussed in the previous section. We then compare the mean WTP for the scope version relative to the base version in the Stratus CV study. This comparison highlights the inappropriate influence of the bid design based on the samples from the same population of respondents. According to the Stratus design, the scope version focuses only on the lake, not the river. The lake is about half the size of the river in terms of miles. Moreover, according to the Stratus design, the acceleration of restoration for the lake is markedly different in the two versions. According to the Stratus design, the scope version, the acceleration of restoration is much smaller. Specifically, the acceleration is only 10 years of difference, from 60 years to 50 years. If people ignored the confounding effects we described in the previous section, economic principles predict that the mean WTP would be smaller in the scope version.⁵⁰ However, comparison to the base version reveals the influence of the bid design. The mean WTP for the scope version is 75 percent of the mean WTP for the base version. If one were to believe the WTP results from the Status CV study, then Oklahoma residents are willing to pay \$138 dollars to accelerate restoration of Tenkiller Lake from 50 years to 60 years, but are willing to pay less than \$46 (\$184 minus \$138) to accelerate restoration in the Illinois River by 40 years. (Because the base version also accelerates the recovery of the lake at a rate faster than that described in the scope version, presumably some of the residual \$46 would reflect an even faster recovery for the

⁵⁰ NOAA has warned against selecting two levels that are so vastly different that passing a scope test is a foregone conclusion (59 *Fed. Reg.* 1146).

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lake.) This illogical conclusion is the result of the bid design, not the true preferences of Oklahoma residents. Of course, these interpretations require one to ignore the confounding effects we discussed in the previous section.⁵¹

4.6 The Stratus survey contains nonresponse bias.

The response rate reflects the portion of the intended sample that actually participates in the study. The consequence of a low response rate is nonresponse bias in the data. This bias occurs when respondents to the survey are systematically different from those who do not respond. The most serious concern about nonresponse bias is that there are likely to be unknown and in fact unknowable differences between nonrespondents and the people who completed the survey.⁵² As the empirical analysis described in Section 5 demonstrates, the WTP models vary substantially with differences in individual characteristics, attitudes, and experiences. To merely make adjustments for differences in a few demographic characteristics as the Stratus report does, is not to account for the most serious consequences of nonresponse bias. As a result, the data collected do not accurately reflect the responses of the target population. CV surveys with a high nonresponse rate (or a low response rate) are considered “unreliable” by the NOAA Panel (Arrow, et al. 1993).

The response rate is a critical indicator of the quality of the data from the study. For the Stratus study, the response rate ranged between 52 to 57 percent depending on various assumptions of eligibility and other survey features. According to Smith (2007), the NOAA Panel defined 70 percent as a high response rate. The response rate of a similar CV study conducted for NRD purposes was 72.6 percent (Carson, et al. 1994). As the Stratus report indicates, the Office of Management and Budget (OMB) guidelines for conducting surveys (2006) establish a threshold response rate of

⁵¹ Additional evidence supporting the perspective presented in this section include Carson, et al. 1996 and Dunford, et al. 1996. For example, in Carson, et al. (1996) dropping the highest bid offered (\$220) lowers the mean from \$85 to \$56, or a decrease of 34 percent. Dunford, et al. (1996) re-estimate the COS mean using alternative bid structures. They find that adding a higher bid of \$400 increases the mean to \$124, an increase of 48 percent. This degree of sensitivity to the bid structure indicates an overall lack of reliability of the CV method, especially because the selection of bids is essentially arbitrary, resting solely under the control of the survey designers.

⁵² Smith (2007) discusses the problem as one of unobserved heterogeneity. That is, respondents and nonrespondents differ in ways that cannot be measured leading to un-interpretable results.

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80 percent. The response rate in the Stratus CV study is substantially below all of these benchmarks.

In an attempt to address nonresponse bias in its CV data, Stratus uses available demographic information to re-weight the data. In addition, Stratus implements only two of the several analytical assessments recommended by OMB for surveys with response rates below 80 percent. First, Stratus compares the age, gender, race/ethnicity, and educational distributions of the survey respondents to Census data for Oklahoma. From this analysis, Stratus concludes that the survey respondents mirror the State residents with respect to these four demographic characteristics. Second, Stratus compares the percentage of “for” votes for the early and late respondents and the percentage of “for” votes for easy and difficult respondents. They found no statistical difference between the proportions of “for” votes in these groupings.

However, neither of these two analyses mitigates the nonresponse bias in the data. With respect to the first analysis, none of the four demographic characteristics influenced how the survey respondents voted. Specifically, none of the statistical models (i.e., logit models) developed by Stratus reflect these four demographic features. Instead, the models reflect that income, recreation frequency, and several opinions about the alleged problem and the proposed solution influenced the voting. Stratus has not established that any of these primary influences on the voting patterns is correlated with these four demographic characteristics. Moreover, Stratus has not, and cannot demonstrate that the nonrespondents would have had patterns of use or income, or attitudes that match those of the survey respondents. Accordingly, the demographic analysis does little to mitigate nonresponse bias in these CV data.⁵³

In terms of the second analysis, the underlying assumption is that the nonrespondents are similar to the late and/or difficult respondents. The presumption is that had the nonrespondents participated, they would be like the late and/or difficult respondents. Stratus is asserting that because the late and/or difficult to reach respondents do not have different voting patterns than do the early and/or easy

⁵³ OMB Circular A-4 reveals that “caution should be used in assessing the representativeness of the sample based solely on demographic profiles.”

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respondents, the overall vote would have not been any different. These assumptions and assertions do not address nonresponse bias. Clearly, there is something different about the nonrespondents relative to the late and/or difficult respondents. For reasons unknown, the nonrespondents chose to not participate in the study, despite several attempts to contact them. Given that the nonrespondents comprise well more than 40 percent of the sample households, their votes could have changed the outcome. Despite these limited analyses conducted by Stratus, nonresponse bias remains in the data.

The important implication of nonresponse bias in this assessment is the resulting inappropriateness of multiplying the average WTP from the CV survey by the total number of households in the 63 counties. Because the Stratus CV survey results reflect nonresponse bias, applying the WTP results to 1.4 million households is not appropriate, further underscoring the fact that the CV survey damage results are not reliable.

4.7 The damage estimates do not correspond to the proper economic baseline.

Finally, the Stratus damage estimate does not comport with the appropriate economic baseline conditions. In economic analysis, it is critical to establish the appropriate baseline conditions, which would be the aesthetic and ecosystem conditions but for the release of phosphorous from the application of poultry litter. Thus, it is necessary to net out the effects of other sources of phosphorous and their impact on water quality in the Illinois River System and Tenkiller Lake. The Stratus damage estimate does not reflect an appropriate baseline because it measures damages relative to hypothetical conditions in 1960. As Connolly, Sullivan, and Coale (2009) point out, there is no data to establish the conditions in 1960, and certainly no basis to argue that the photographs that were used to represent baseline actually reflected the conditions in 1960.⁵⁴ Furthermore, the damages estimated from the CV study reflect all of the past phosphorus in the Illinois River System and Tenkiller Lake.

⁵⁴ This means that rather than 48 years of the difference in aesthetics, the damages should be based on 27 years. Moreover, the past damages report prepared by Stratus confirms that the annual change in the visual aesthetics was constant over time. Thus, even if the damages were based on a valid estimate they are further inflated by this error.

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According to the Stratus CV questionnaire, about 60 percent of the phosphorus is attributable to the poultry industry. However, as designed, the CV survey results reflect the purported value associated with **all** of the past phosphorus, not just the portion attributable to the poultry industry. Thus, the Stratus damages estimate, even if it were valid and reliable, does not correspond to the appropriate economic baseline conditions.

4.8 The Stratus CV survey does not conform to the NOAA panel guidelines.

The Stratus report contends that it has met the NOAA panel guidelines for conducting CV surveys. As our review has demonstrated, there are meaningful differences between the Stratus CV and the NOAA panel guidelines. In fact, the Stratus CV survey fails 16 out of the 24, or two-thirds, of the applicable guidelines. Moreover, the guidelines that they met are insufficient to overcome the serious flaws in the study. Table 4.10 below highlights these differences.

Table 4.10: Summary Table of NOAA Panel Guidelines

NOAA Panel Guideline	Sufficiently Addressed in Stratus CV Study?	Discussion of Items Not Sufficiently Addressed
Sample Size and Type	No	The different sample sizes for the base and scope versions influences the scope test results. With comparable sample sizes, the study would not meet the scope test guidelines.
Nonresponse Bias	No	The response rate is 52 percent, well below the guidelines set by NOAA and OMB. The nonresponse analysis does not address how the nonrespondents differ from the respondents in terms of the respondent opinions and experiences that influenced their votes on the program.
In-person Interviews	Yes	
Test for Interviewer Effects	No	Stratus conducted hotel pretests that purport to demonstrate that the in-person interviewer format did not affect voting patterns relative to a self-administered survey. However, the ballot box research described by Harrison (2007) indicates strong interviewer effects. Moreover, Stratus did not include design elements recommended by NOAA panel, such as a ballot box or mail-in survey component (Leggett, et al. 2003). In some in-person studies, individual interviewers can unduly sway the results (Leggett, et al. 2003).

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NOAA Panel Guideline	Sufficiently Addressed in Stratus CV Study?	Discussion of Items Not Sufficiently Addressed
Data Reporting	Yes	
Careful Pretesting	No	The amount of pretesting does not correspond to careful pretesting. Careful pretesting would have documented the salient changes in the questionnaire over time, and the evolution of the bid levels used (Smith 2007). Moreover, the NOAA Panel guidelines indicate that careful pretesting will result in respondent comprehension and acceptance, which this study fails to demonstrate.
Conservative Design	No	The CV questionnaire is not balanced in terms of presenting information on the poultry industry and other sources of phosphorus. The CV questionnaire provides significant information dosing about the poultry impacts on water conditions before asking respondents' impressions of the resources, a sharp contrast to the earlier Stratus telephone survey.
WTP Elicitation Format	Yes	
Referendum Format*	Yes	
Accurate Description of Injury and Proposed Program	No	The information presented is at odds with available scientific information. Moreover, the damage estimate that results from the survey reflects injury from all past sources, not uniquely the poultry industry defendants. Because the described alum treatment does not distinguish the source of the phosphorus, the CV results are not relevant for damage assessment, as the NOAA Panel guidelines indicate.
Pretest Photographs	No	Although Stratus included photos in the pretests, they did not evaluate and report on any potential biases associated with various photographs. Moreover, the use of the photos exaggerates the purported injury because they do not portray the spatial and seasonal extent of algae conditions.
Reminder of Undamaged Substitutes**	Yes	
Adequate time lapse from incident	No	The NOAA Panel included this guideline to address frequent and biased media coverage of the environmental changes. The Attorney General filed this suit in 2005, and the media coverage has increased awareness of the algae conditions over the last year. In 2006, when Stratus conducted its telephone survey, less than 10 percent of the respondents volunteered any negative impressions of the resources. The majority of the 2006 respondents indicated that the river and lake were high-quality recreation resources, with clean and clear water.
Temporal Averaging	N/A	

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NOAA Panel Guideline	Sufficiently Addressed in Stratus CV Study?	Discussion of Items Not Sufficiently Addressed
No answer option	No	The no-answer option was not included in this study. Harrison (2007) provides a dissection of the research on which Stratus relies when claiming that this guideline is irrelevant. Harrison demonstrates that the results are sensitive to interpretation and contrary to the information presented by Stratus.
Yes/No Follow-ups	No	Although the questionnaire included yes/no follow-ups to the WTP question, the results were not factored into the analysis, which was the intent of the NOAA Panel (Smith 2007). For example, about 40 percent of the respondents believed that the extra taxes would be used to clean up other lakes and rivers. Although these respondents are clearly thinking about a much broader suite of resources when they voted yes, and the analysis should have at least controlled for them.
Cross Tabulations	Yes	
Checks on Understanding and Acceptance	No	Although the questionnaire included questions that would reveal whether the respondents understood and accepted the scenario, the analysis of the results indicates that many respondents did not understand and/or accept the scenario.
Alternative Expenditure Possibilities	No	The "budget constraint," or reminder of alternative expenditure possibilities should be more than perfunctory, according to the NOAA Panel guidelines. The analysis conducted indicates that respondents did not consider their incomes during the hypothetical voting. With almost one third of respondents not paying income state income taxes, the budget constraint is ineffective.
Deflection of Transaction Value	No	The follow-up questions indicate that many respondents voted before the program because it would help the environment "in general." These respondents were not thinking of the specific resources at issue when they voted.
Steady State or Interim Losses	Yes	
Present Value of Interim Losses	Yes	
Advanced Approval	No	Stratus did not seek advance approval of the defendants.
Burden of Proof	No	The response rate does not meet the established thresholds. Many respondents did not understand or accept the scenario described by the interviewers. The scope test result depends entirely on the chosen statistical technique (see below).
Scope Test	No	The scope test result is a statistical artifact of the large sample size. Moreover, the scope test does not vary only one dimension, which leads to a confounding effect.

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NOAA Panel Guideline	Sufficiently Addressed in Stratus CV Study?	Discussion of Items Not Sufficiently Addressed
<p>* The hypothetical referendum format does not give the same results as a real referendum and provides no counter to hypothetical bias.</p> <p>** Even though a substitute's reminder was included, more than 40 percent thought the hypothetical program would benefit other resources.</p>		

Moreover, the following list details more differences between the Stratus CV and the NOAA panel guidelines:

- The survey design is not conservative as respondents were repeatedly dosed with information that either was factually incorrect, misleading, or unbalanced in its presentation. Respondents were given no information about potential economic tradeoffs, nor were respondents told about the potential uncertainty surrounding the proposed restoration project and the purported injuries to fish and other biota.
- The photographs are biased because they fail to remind respondents that the purported impacts would be seasonal and would only affect a portion of the lake. Plaintiffs do not make clear the portion of the lake that would be affected. The photographs also do not correspond to the stated conditions in the survey questionnaire.
- Budget constraint is merely perfunctory in the Stratus survey. Moreover, it is irrelevant for approximately one-third of the Stratus survey respondents who either got a full-refund or paid no state income taxes.

The Stratus survey does not fulfill the guidelines for a valid CV survey (nonresponse, scope, understanding, scenario acceptance). It does not include a valid scope test. Respondents routinely provided that answers that demonstrated that they ignored what was said in the survey interview as it related to the specific commodity that was to be valued. Moreover, the respondents' answers do not correspond to basic economic principles of the law of demand and income elasticity. Such failings are more than sufficient to indicate that the Stratus survey is not a valid basis for measuring damages.

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4.9 References

51 *Fed. Reg.* 27751, 1986

Adamowicz, W., J. Louviere, and M. Williams. 1994. Combining Real and Stated Preference Methods for Valuing Environmental Amenities. *Journal of Environmental Economics and Management* 26: 271-292.

Arrow, Kenneth, Edward Leamer, Howard Schuman, and Robert Solow. 1994. "Comments on NOAA Proposed Rule on Natural Resource Damage Assessment", in *Comments on Proposed NOAA/DOI Regulations on Natural Resource Damage Assessment*, EPA, October 1994.

Arrow, K., R. Solow, P.R. Portnoy, E.E. Leamer, R. Radner, and H. Schuman. 1993. "Report of the NOAA Panel on Contingent Valuation." 58 *Fed. Reg.* 4601 *et seq.* Jan. 15.

Bierman, Victor, Jr., Ph.D. 2009. "Expert Report of Victor J. Bierman, Jr. in the Matter of *State of Oklahoma, et al., Plaintiffs v. Tyson Foods, Inc., et al., Defendants*. United States District Court for the Northern District of Oklahoma. Case No. 05-CV-0329-GKF-SAJ. January 23.

Bishop Corr 0000126

Bishop undated. Notes on Hypothetical Bias. Bishop0001271_Notes on Hypothetical Bias.doc

Blumenschein, Karen, Magnus Johannesson, Glenn C. Blomquist, Bengt Liljas, and Richard M. O'Connor. 1998. "Experimental Results on Expressed Certainty and Hypothetical Bias in Contingent Valuation." *Southern Economic Journal* 65(1):169-177.

Carson, R.T. and T. Groves. 2007. "Incentive and informational properties of preference questions." *Environmental and Resource Economics*. 37:181–210.

Carson, R. T. 1997. "Contingent Valuation Surveys and Tests of Insensitivity to Scope", in R. J. Kopp, W. Pommerhene and N. Schwartz, eds., *Determining the Value of Non-Marketed Goods: Economic, Psychological, and Policy Relevant Aspects of Contingent Valuation Methods*. Boston: Kluwer, pp. 127–163.

Carson, R.T., Flores, N.E. and Meade, N.F. 2001. "Contingent Valuation: Controversies and Evidence." *Environmental and Resource Economics* 19: 173–210.

Carson, Richard T., Robert Cameron Mitchell, W. Michael Hanemann, Raymond J. Kopp, Stanley Presser, and Paul A. Rudd. 2003. *A Contingent Valuation Study of Lost Passive Use Values Resulting From the Exxon Valdez Oil Spill*. *Environmental and Resource Economics* 25: 257–286.

March 31, 2009

Carson, Richard T., Michael B. Conaway, W. Michael Hanemann, Jon A. Krosnick, Kerry M. Martin, Donald R. McCubbin, Robert Cameron Mitchell, and Stanley Presser. 1996. *The Value of Preventing Oil Spills to Natural Resources Along California's Central Coast*. Report prepared for the California Department of Justice, the Office of Oil Spill Prevention and Response in the California Department of Fish and Game, and the Damage Assessment Center of the National Oceanic and Atmospheric Administration. San Diego, CA: Natural Resource Damage Assessment, Inc.

Carson, Richard T., W. Michael Hanemann, Raymond J. Kopp, Jon A. Krosnick, Robert C. Mitchell, Stanley Presser, Paul A. Ruud, and V. Kerry Smith. 1994. *Prospective Interim Lost Use Value Due to DDT and PCB Contamination in the Southern California Bight*. Report prepared for the National Oceanic and Atmospheric Administration. La Jolla, CA: Natural Resource Damage Assessment, Inc. September 30.

Champ, Patricia A., and Richard C. Bishop. 2001. "Donation Payment Mechanisms and Contingent Valuation: An Empirical Study of Hypothetical Bias." *Environmental and Resource Economics* 19:383-402.

Champ, Patricia A., Richard C. Bishop, Thomas C. Brown, and Daniel W. McCollum. 1997. "Using Donation Mechanisms to Value Nonuse Benefits from Public Goods." *Journal of Environmental Economics and Management* 33:151-162.

Code of Federal Regulations. 43 CFR Part 11.

Connolly, John P. 2009. "Expert Report of John P. Connolly: Illinois River Watershed Water Quality and Source Assessment." Prepared for: Illinois River Watershed Joint Defense Group. Quantitative Environmental Analysis, LLC: Montvale, NJ. January 30.

Connolly, John P., Ph.D., Timothy Sullivan, Ph.D., and Frank Coale, Ph.D. 2009. Expert report in the matter of *State of Oklahoma v. Tyson Foods, et al.* Evaluation of Hypothetical Remediation Strategy Presented in Stratus Contingent Value Study Illinois River Watershed. March.

Cooke, Dennis. 2008. Expert testimony of Dr. Dennis King in the Matter of *W.A. Drew Edmondson, in his capacity as Attorney General of the State of Oklahoma and Oklahoma Secretary of the Environment C. Miles Tolbert in his capacity as the Trustee for Natural Resources for the State of Oklahoma vs. Tyson Foods, et al.* January 30. In the United States District Court for the Northern District Of Oklahoma. CV-00329-TCK-SAJ

Desvousges, W.H., D.J. MacNair, and G.A. Smith. 2000. *Lower Fox River and Bay of Green Bay: Assessment of Potential Recreational Fishing Losses and Restoration Offsets*. Durham, NC: Triangle Economic Research.

Desvousges, W.H., S.P. Hudson, and M.C. Ruby. 1996. "Evaluating CV Performance: Separating the Light From the Heat." In *The Contingent Valuation of*

March 31, 2009

Environmental Resources: Methodological Issues and Research Needs, eds. D.J. Bjornstad and J.R. Kahn. Brookfield, VT: Edward Elgar Publishing Limited.

Desvousges, William H., F. Reed Johnson, Richard W. Dunford, Kevin J. Boyle, Sara Hudson, and K. Nicole Wilson. 1993. "Measuring Natural Resource Damages with Contingent Valuation: Tests of Validity and Reliability." In *Contingent Valuation: A Critical Assessment*, edited by Jerry A. Hausman. Amsterdam: North Holland Publishers.

Diamond, P.A. and J.A. Hausman. 1994. "Contingent valuation: is some number better than no number?" *Journal of Economic Perspectives* 8(4): 45–64.

Diamond, P.A. and J.A. Hausman, ed. 1993. "On Contingent Valuation Measurement of Nonuse Values." In *Contingent Valuation: A Critical Assessment*. Amsterdam: Elsevier Science Publishers B.V.

Dunford, Richard, Alicia R. Gable, Sara P. Hudson, William H. Desvousges, and F. Reed Johnson. 1996. *A Review of the 1996 Contingent Valuation Study on the Value of Preventing Oil Spills Along California's Central Coast*. Durham, NC: Triangle Economic Research. October.

Ethier, R.G., Poe, G.L., Schulze, W.D., Clark, J., 2000. "A comparison of hypothetical phone and mail contingent valuation responses for green-pricing electricity programs." *Land Economics* 76: 54–67.

Fisher, A.C. 1996. "The conceptual underpinnings of the contingent valuation method." In *The Contingent Valuation of Environmental Resources: Methodological Issues and Research Needs*, eds. D.J. Bjornstad and J.R. Kahn. Brookfield, VT: Edward Elgar Publishing Limited.

Freeman III, A.M. 1993. *The Measurement of Environmental and Resource Values*. Washington, DC: Resources for the Future.

Green, D., K.E. Jacowitz, D. Kahneman, and D. McFadden. 1998. "Referendum contingent valuation, anchoring, and willingness to pay for public goods." *Resource and Energy Economics* 20(2): 85–116.

Harrison, Glenn W. 2007. "Making Choice Studies Incentive Compatible." In *Valuing Environmental Amenities Using Stated Choice Studies: A Common Sense Approach to Theory and Practice*, ed. Barbara Kanninen. Dordrecht, The Netherlands: Springer.

Horowitz, John. 2000. "Discussion of Theory and Design of Stated Preference Methods." Stated Preference: What Do We Know? Where Do We Go? A Workshop Sponsored by the USEPA's National Center for Environmental Economics and National Center for Environmental Research. Washington, DC: October 12.

March 31, 2009

- Kahneman, Daniel and Jack Knetsch. 1992. "Valuing Public Goods: The Purchase of Moral Satisfaction." *Journal of Environmental Economics and Management* . 22: 57-70.
- Kanninen, B.J., 1995. "Bias in discrete response contingent valuation." *Journal of Environmental Economics and Management* 28: 114–125.
- Kemp, M.A. and C. Maxwell. 1993. "Exploring a Budget Context for Contingent Valuation Studies." *Contingent Valuation: A Critical Assessment*, ed. J.A. Hausman. Amsterdam: Elsevier Science Publishers B.V.
- King, Todd. 2009. Expert testimony of Todd King in the Matter of *W.A. Drew Edmondson, in his capacity as Attorney General of the State of Oklahoma and Oklahoma Secretary of the Environment C. Miles Tolbert in his capacity as the Trustee for Natural Resources for the State of Oklahoma vs. Tyson Foods, et al.* January 30. In the United States District Court for the Northern District Of Oklahoma. CV-00329-TCK-SAJ
- King, Todd. 2008. "Identification and Evaluation of Viable Remediation Alternatives to address Injuries related to Land Disposal of Poultry Waste within the Illinois River Watershed." May 15.
- Leggett, Christopher G., Naomi S. Kleckner, Kevin J. Boyle, John W. Duffield, and Robert Cameron Mitchell. 2003. "Social Desirability Bias in Contingent Valuation Surveys Administered Through In-Person Interviews." *Land Economics* 79(4): 561-575.
- Mathews, K.E., M.L. Freeman, and W.H. Desvousges. 2007. "How and How Much? The Role of Information in CE Questionnaires." In *Using Choice Experiments to Value Environmental Amenities*, Barbara Kanninen, ed. Boston: Kluwer Academic Publishers.
- Mitchell, Robert Cameron and Richard T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Washington, DC: Resources for the Future, Inc.
- Morey, Edward 2006. "Some Initial Thoughts on the Phone Survey." Draft. November 28.
- OMB 2006. *Standards and Guidelines for Statistical Surveys*. Office of Management and Budget. Washington, DC. September.
- Poe, Gregory L., Jeremy E. Clark, Daniel Rondeau, and William D. Schulze. 2002. "Provision Point Mechanisms and Field Validity Tests of Contingent Valuation." *Environmental and Resource Economics* 23:105–131.
- Presser, S., J. Blair, and T. Triplett. 1992. "Survey Sponsorship, Response Rates, and Response Effects." *Social Science Quarterly* 73(3): 699–702.

March 31, 2009

- Rea, Louis M. and Richard A. Parker. 2005. *Designing and Conducting Survey Research: A Comprehensive Guide*. San Francisco: Josey-Bass Publishers.
- Rossi, P., J. Wright, and A. Anderson. 1983. *Handbook of Survey Research*. New York: Academic Press, page 215.
- Rowe, R.D., R. d'Arge, and D.S. Brookshire. 1980. "An Experiment on the Economic Value of Visibility." *Journal of Environmental Economics and Management* 7:1–19.
- Schläpfer, F. 2008. "Contingent valuation: A new perspective." *Ecological Economics* 64(4): 729-740.
- Schläpfer, F. and I. Bräuer. 2007. "Theoretical incentive properties of contingent valuation questions: do they matter in the field." *Ecological Economics* 62: 451–460.
- Schulze, W.D., G.H. McClelland, J.K. Lazo, and R.D. Rowe. 1998. "Embedding and Calibration in Measuring Non-Use Values." *Resource and Energy Economics* 20, 163–178.
- Schuman, H. and S. Presser. 1981. *Questions and Answers in Attitude Surveys*. New York: Academic Press.
- Slovic, P., B. Fischhoff, and S. Lichtenstein. 1982. "Facts versus Fears: Understanding Perceived Risks." In *Judgment Under Uncertainty: Heuristics and Biases*, eds. D. Kahneman, P. Slovic, and A. Tversky. Cambridge: Cambridge University Press.
- Smith, V. Kerry. 2007. "Judging Quality." In *Valuing Environmental Amenities Using Stated Choice Studies: A Common Sense Approach to Theory and Practice*, ed. Barbara Kanninen. Dordrecht, The Netherlands: Springer.
- Smith, V.K. 1986. "To Keep or Toss the Contingent Valuation Method." In *Valuing Environmental Goods: An Assessment of the Contingent Valuation Method*, eds. R.G. Cummings, D. Brookshire, and W.D. Schulze. Totowa, NJ: Rowman and Allanheld.
- Smith, V. K. and L. Osborne. 1996. "Do Contingent Valuation Estimates Pass a Scope Test? A Meta Analysis." *Journal of Environmental Economics and Management* 31: 287–301.
- Stratus 2007. "Oklahoma Watershed Short Telephone Survey Report (Draft)." March 29. (Stratus0027772_STS.Draft_NEW.doc)
- Swait, J., J.J. Louviere, and M. Williams. 1994. "A Sequential Approach to Exploiting the Combined Strengths of SP and RP Data: Application to Freight Shipper Choice." *Transportation* 21:135–152.

March 31, 2009

- Tourangeau, Roger, Lance J. Rips, and Kenneth Rasinski. 2000. *The Psychology of Survey Response*. Cambridge: Cambridge University Press.
- Tversky, A. and D. Kahneman. 1981. "The Framing of Decisions and the Psychology of Choice." *Science* 211(January 30):453–458.
- Vossler, Christian A. and Joe Kerkvliet. 2003. "A Criterion Validity Test of the Contingent Valuation Method: Comparing Hypothetical and Actual Voting Behavior for a Public Referendum." *Journal of Environmental Economics and Management* 45:631–649.
- Vossler, Christian A., Joe Kerkvliet, Stephen Polasky, and Olesya Gainutdinova. 2003. Externally Validating Contingent Valuation: An Open-Space Survey and Referendum in Corvallis, Oregon. *Journal of Economic Behavior and Organization* 51:261–277.
- Weinstein, M.C. and R.J. Quinn. 1983. "Psychological Considerations in Valuing Health Risk Reductions." *Natural Resources Journal* 23(3):659–673.
- Whittington, D., G. Cassidy, D. Amaral, E. McClelland, H. Wang, and C. Poulous. 1994. "The Economic Value of Improving the Environmental Quality of Galveston Bay." The Galveston Bay Estuary Program.

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5. BIASES RESULTING FROM STATISTICAL AND ECONOMETRIC ANALYSES

In this section, we examine the statistical and econometric analyses presented in the Stratus CV Report. We isolate a number of important biases in the reported scope test estimates of WTP, as well as a number of inherent violations of fundamental principles. Our focus is on the robustness, or lack thereof, of the reported estimates. None of the WTP estimates generated as part of this robustness analysis should be viewed as a basis for an alternative measure of damages.

5.1 Stratus employs a non-parametric estimator of WTP, resulting in unreliable WTP estimates.

The Stratus Report overestimates the WTP that can properly be based upon the survey data. The WTP measures presented in the Stratus report use the nonparametric ABERS estimator. We tested the robustness of the ABERS estimator by employing, instead, the nonparametric Turnbull estimator and found that the Turnbull estimator produced more conservative estimates of WTP. Although they are more conservative, as we show below, neither of these approaches produces valid a WTP estimate.⁵⁵

The ABERS and Turnbull estimators assume that the probability that WTP is below a certain dollar amount increases as that dollar amount grows. For example, if there is a 50-percent likelihood that respondents' WTP will be \$10 for a specified restoration effort, that probability would be expected to decline (hypothetically to perhaps 20%) as the price tag increases to \$25. This relationship is known as a monotonically increasing cumulative distribution function for WTP. Both estimations rely on a recursive process, comparing frequencies of "no" votes for two bid amounts at

⁵⁵ These nonparametric approaches are more reliable than parametric estimators because they avoid assumptions regarding the distribution of WTP between bid amounts. Parametric estimators interpolate data between bid amounts so that every dollar amount is associated with some number of people who hypothetically exhibit that WTP. For example, although we do not have any vote data for bids of \$172.50, parametric estimators assume that some frequency of people who said "No" to a bid of "\$205" would say "Yes" to \$172.50. This interpolated frequency is extremely sensitive to the distributional assumptions made and results in unreliable WTP estimates.

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a time.⁵⁶ If the higher bid amount is always associated with a higher frequency of “no” votes, the ABERS and Turnbull estimators yield the same WTP.

When this is not the case, the ABERS and Turnbull estimators proceed by taking the weighted average of frequencies for the two bids. However, the ABERS procedure assigns this new frequency to both bids, while the Turnbull estimator assigns this new frequency to the lower bid and effectively drops the higher bid. By continuing to weight the higher bid, the ABERS estimator artificially creates a lower bound WTP for people who reject the next higher bid.

For example, suppose the “Yes” vote frequencies for \$80 and \$125 contradict the existence of a monotonically increasing cumulative distribution function. If the new ABERS frequency of a “Yes” vote for both these bids is 0.50 and the empirical frequency of a “Yes” vote for a \$205 bid is 0.30, the ABERS estimation procedure assumes that the difference of 0.20 is caused by people having valuations between \$125 and \$205. In contrast, the Turnbull estimator drops the \$125 bid entirely so that the \$125 does not act as a “bottom floor” for WTP. In other words, the ABERS estimator places artificial lower bounds at arbitrary bid amounts, resulting in WTP estimates that are biased upward.

In describing its WTP estimation procedure, the Stratus report states: “... the estimated mean converges to the true mean of the distribution from below, meaning that the estimated mean underestimates the true mean in finite data sets.”⁵⁷ This statement wrongly implies that the ABERS WTP always underestimates the hypothetical “true” WTP, which is achieved as sample sizes approach infinity. This is only accurate when the original method of smoothing the cumulative distribution function is correct. A more accurate description is that the ABERS estimator will arrive at a larger WTP in response to increases in the maximum bid, as is true with the Turnbull estimator. However, the WTP derived from the ABERS estimator will

⁵⁶ The cumulative distribution function is the probability that WTP is lower than a given bid, or that a respondent will cast a “No” vote. The distribution of “Yes” Votes for a Population is thus one minus the cumulative distribution function at every point, so that an increasing cumulative distribution function is equivalent to a decreasing distribution of “Yes” votes.

⁵⁷ The “mean” refers to WTP, which is calculated as the mean of the cumulative distribution function, Stratus Report, Vol I, p. 166.

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consistently be equal to or higher than the WTP derived from the Turnbull estimator for any finite sample. There is no statistical justification for the implication in Stratus' report that the ABERS estimator would systematically underestimate true WTP. If the ABERS estimate of the cumulative distribution overemphasizes larger WTP by creating "bottom floors," the ABERS estimates and resulting WTP calculations will also result in overestimates, as is the case here.

There are also differences in the calculation of standard errors to form confidence intervals. Following the Stratus report, we use a jackknife bootstrap⁵⁸ to obtain standard errors for ABERS estimates, as well as confidence intervals for empirical cumulative distributions throughout this analysis. However, since the jackknife procedure requires more than one primary sampling unit in a stratum, the structure of the survey makes it impossible to use the jackknife procedure on many subpopulations of interest, such as passive versus active users, in the survey. When this is the case for the ABERS estimate, we leave the appropriate column/row blank. For the Turnbull estimator, we use asymptotic theory throughout to generate standard errors for every subpopulation.⁵⁹

In light of the strong biases present throughout the contingent valuation method employed by Stratus that generate higher WTP estimates, it is especially important that the valuation methods employed avoid contributing further positive bias. We examined the ABERS and Turnbull WTP, using 95% confidence intervals for the entire population and the empirical distribution of "Yes" votes for that population expressed as "Pr" or the "probability" of a Yes vote at the associated bid level.⁶⁰ The distribution of "Yes" votes (equivalent to 1 minus the cumulative distribution function) is not monotonically decreasing. As a result, WTP derived using the ABERS estimator adopted by Stratus is greater than the estimated WTP using the Turnbull estimator, as indicated in Table 5.1.

⁵⁸ A jackknife procedure estimates standard errors of estimates by repeatedly calculating the estimator, leaving out a single different observation each time. When there is a single primary sampling unit in a survey stratum, the jackknife has no way to re-estimate and thus cannot be implemented.

⁵⁹ This is the most common procedure for estimating standard errors. For specific use in non-market valuation see Haab T.C. and McConnell K.E. 2002. "Valuing Environmental and Natural Resources."

⁶⁰ The cumulative distribution function is the probability that WTP is lower than a given bid, or that a respondent will give a "No" vote. The distribution of "Yes" Votes for a Population is thus one minus the cumulative distribution function at every point so that an increasing cumulative distribution function is equivalent to a decreasing distribution of "Yes" votes.

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While the ABERS estimate of WTP is \$184.44 (based on a 95% confidence interval of \$165.72 to \$203.38), the Turnbull estimate is almost \$6 lower, at \$176.78 (based on a 95% confidence interval of \$160.09 to \$193.42). As previously explained, these divergent WTP estimates are due to the difference in smoothing procedures for the ABERS and Turnbull estimators. Any WTP estimates for subpopulations of respondents who display a similarly inconsistent decline in “yes” votes as the bid increases (e.g., an *increase* in the number of respondents voting “yes” when the bid increases from \$80 to \$125 as displayed for the total population in Table 5.1) will similarly result in overestimates of WTP using ABERS, as discussed in the next section of this report.

Table 5.1: Application of ABERS and Turnbull Estimators Producing Different WTP from Same Data

<u>Empirical Distribution Of “Yes” Votes for Population</u>			
	Bid Amount	Pr (Yes Bid)	
	\$10.00	0.815	
	\$45.00	0.701	
	\$80.00	0.602	
	\$125.00	0.615	
	\$205.00	0.435	
	\$405.00	0.342	
	WTP	95% lower	95% upper
ABERS	\$184.55	\$165.72	\$203.38
Turnbull	\$176.78	\$160.09	\$193.42

5.2 Analysis of Subgroups of Respondents

In addition to examining Stratus’ results for the entire surveyed population, we compared estimated WTP for several key subpopulations to determine whether the results are consistent with economic logic. This is a standard approach to evaluating the robustness of claimed survey results. The subpopulations tested were based upon: 1) the nature of the respondent’s use of the natural resources (either active or passive), 2) respondent’s perception of the effectiveness of the proposed alum treatment, 3) difficulty respondent would likely have in paying the proposed alum tax, and 4)

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respondent's opinions regarding levels of state spending on pollution. Comparison of active and passive users suggests that the survey is flawed because its results run contrary to fundamental economic logic: using the Turnbull estimator, passive users of Tenkiller Lake have a higher WTP for its restoration than do active users. The other sub-groups of respondents demonstrate such marked differences in WTP that the survey cannot be used to represent the views of the population at large without first knowing how that general population is distributed by each defining characteristic.

Passive Versus Active Users

Basic economic principles of demand dictate that as price increases, consumer demand will decrease. In economics, this principle is known as the law of demand. However, particular characteristics of the "buyers" should be expected to influence the value they place on the purchased good, and thus their WTP for it. These characteristics include both the money available to the buyer to make the purchase and the use which the buyer will make of the purchased good.

Extensive academic literature has employed or examined survey methods to estimate the WTP for various types of environmental quality improvements. Kriström and Riera (1996) and Hokby and Soderqvist (2003) review several European studies and find that the income elasticity of WTP for environmental quality improvements is almost always positive, but on average is less than one. These results are consistent with what economists would describe as "normal goods," which are not viewed as luxuries. This conclusion has been confirmed by Henderson (2008) and Fisher and Waschik (2002). Because environmental quality is a "normal good", as household income rises, the WTP for improvements to environmental quality also rises (Organization for Economic Co-operation and Development 2001).

The WTP for active users of Tenkiller Lake contradicts this intuition and economic logic. Question 14 asks whether respondents have ever visited the Illinois River and Question 15 elicits the same information for Tenkiller Lake. Respondents who have visited either the river or the lake are considered "Active" users of that area. Among active users of Tenkiller Lake, a higher portion of Stratus respondents were willing to pay \$405 than were willing to pay \$205 for the restoration program.

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We examined the distribution of “Yes” votes, conditional on both bid amount and WTP for passive and active users of both the river and the lake. As expected, active users of the Illinois River have a higher WTP than passive users of that same resource. These results appear in Appendix C. In contrast, active users of the lake have a **lower** Turnbull WTP (\$135) than do passive users of that same resource (\$142). This is due to the non-monotonically decreasing empirical distribution for active users of the lake. In particular, the distribution increases from 0.46 to 0.49 for bids \$205 and \$405, respectively. As previously explained, while the ABERS estimator takes a weighted average of these proportions and assigns them to both bids, the Turnbull estimator assigns this weighted average to the \$205 bid and ignores the \$405 bid. This type of behavior in the data illustrates why the profession generally prefers the Turnbull estimator to the ABERS estimator, especially in light of the many upward biases in the Stratus survey. The large difference between bids in this case is the driving factor for the large difference in WTP estimates and points to the unreliability of the valuation technique.

Table 5.2: Comparison of WTP for Active v. Passive Users of Tenkiller Lake

Q15: Have you ever visited Tenkiller Lake?

	No (Passive Users)			Yes (Active Users)		
	WTP	Lower 95%	Upper 95%	WTP	Lower 95%	Upper 95%
ABERS	\$149.89			\$216.83		
TRNBL	\$142.08	\$114.13	\$170.04	\$135.00	\$126.28	\$143.72
	Pr(Yes Bid)	Lower 95%	Upper 95%	Pr(Yes Bid)	Lower 95%	Upper 95%
\$10	0.76	0.76	0.76	0.87	0.87	0.87
\$45	0.69	0.69	0.69	0.72	0.72	0.72
\$80	0.55	0.55	0.55	0.65	0.65	0.65
\$125	0.60	0.60	0.60	0.64	0.64	0.64
\$205	0.40	0.40	0.40	0.46	0.46	0.46
\$405	0.20	0.20	0.20	0.49	0.49	0.49

Effectiveness of Alum Treatment

The second subpopulation group tested consisted of respondents who believe that the alum treatment will be “Not”, “Slightly”, or “Moderately” effective as contrasted with those who think the alum treatment will be “Very” or “Extremely” effective. Not surprisingly, respondents viewing the alum treatment as “Very” or “Extremely” effective

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had a WTP more than two times that of the other respondents. More than 60 percent of respondents concluded (after the considerable dosing described above) that the alum treatment would be “Very” or “Extremely” effective; they were willing to pay approximately \$235.29 using the Turnbull estimate. In contrast, 35.5% of respondents believed that the alum treatment would be “Not”, “Slightly”, or “Moderately” effective; these respondents were only willing to pay \$100.88. These differences are statistically significant. Detailed results appear in Appendix C, but it is clear that WTP for the restoration program depends heavily upon what scientific evidence is provided and the conclusions that people draw from it. Under these circumstances, the bias introduced through Stratus’ survey presentation makes it impossible to draw any reliable conclusions.

State Spending on Pollution

The third subpopulation group we examined separated respondents who thought the state should spend “Less” or the “Same” on pollution from those who thought it should spend more. The former group represents 31.58% of the population; while 66.29% believe that the state should spend more to control pollution. Not surprisingly, those respondents who think the state should not increase its spending had a lower WTP (\$119.96 using Turnbull) than did the overall population of respondents (\$176.78 using Turnbull or \$184.55 using ABERS estimators). This difference, for which the details appear in Appendix C, is statistically significant. Because 52.44 percent of all respondents either believe that the state should not increase spending on pollution or believe alum treatment will be no more than moderately effective, or believe both of these things, the views of the general population must at least roughly correspond with these distributions for the survey results to be meaningful in predicting the broader response. Stratus provides no method to extrapolate from these individual characteristics of the sample population to the larger population whose WTP is being estimated.

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5.3 Implied bid and income elasticities are inconsistent with economic theory.

Two standard economic measures known as “elasticities” may also be computed and evaluated for compliance with established economic principles. The elasticity of demand is a well-established economic principle that measures the responsiveness of change in demand for a good or service relative to a change in its price. Income elasticity measures responsiveness to changes in the level of purchasers’ incomes.

The elasticity measures how responsive demand is to a price increase or decrease. When the change in demand corresponds to a change in price, demand for the good is said to have “unitary elasticity.” If, for example, the price increases 10 percent, the demand for the good will fall 10 percent. If the change in demand is greater than the change in price, demand is said to be “elastic.” This occurs when the demand changes more than the price does. For example, a 20 percent decrease in demand that follows a 10 percent increase in price reflects elasticity. By contrast, a change in demand that is smaller than a corresponding price change is said to reflect “inelastic” demand. Certain necessities, such as gasoline and household water, cannot be easily be replaced or dispensed with and are less responsive to price changes than are discretionary goods (Scheierling, Loomis, and Young 2006). These necessities exhibit inelastic demand; consumers must buy them regardless of change in price.

As previously described, a price increase ordinarily results in a decrease in the quantity of an ordinary good purchased by consumers. This relationship is illustrated with the commonly-accepted downward sloping demand curve. A wide body of contingent valuation studies observe that income is positively associated with WTP for aesthetic public goods.⁶¹ In a meta-analysis based on 46 contingent evaluation studies across six continents, Jacobsen and Hanley (2008) conclude that there is a significant positive effect of both personal income and national GDP on WTP for species and

⁶¹ Bateman, I.J., and Langford, I.H. 1997. “Non-users’ Willingness to Pay for a National Park: An Application and Critique of the Contingent Valuation Method.” *Regional Studies* 31(6): 571-582; Ph. Le Goffe. 1995. “The Benefits of Improvements in Coastal Water Quality: A Contingent Approach.” *Journal of Environmental Management* 45: 305-317; Alberini, A., Rosato, P., Longo, A., Zanatta, V. *Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice.* Nota Di Lavoro 19.2004. February 2004.

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habitat conservation.⁶² Where a significant impact of income on WTP is not exhibited, researchers suspect that the reason is flaw in the survey design.⁶³

In this case, it is possible to compute from the Stratus CV results: (1) the elasticity of demand with respect to changes in the hypothetical prices—the cost of the alum treatment program—and (2) the elasticity of demand with respect to changes in respondent income. The bid design, which randomly assigned different costs of the alum treatment program among respondents, and the inclusion of respondent income information in the Stratus CV survey, enable the calculation of these two important elasticities. Thus, an evaluation similar to the scope test determines the sensitivity of the “votes” to changes in the bid price. Because the item being purchased is a hypothetical water quality improvement rather than a unit of goods, the elasticity is measured with quantity represented by the probability of voting yes on the restoration program.⁶⁴ In the Stratus CV survey, the good being purchased is environmental quality, which is an ordinary (rather than luxury) good and should exhibit normal elasticity.

⁶² Jacobsen, B.R., and Hanley, N. 2008. “Are there income effects on global willingness to pay for biodiversity conservation?” *Environmental and Resource Economics* (August).

⁶³ It has been argued that the income elasticities in CV surveys are too low to accord with economic intuition. In a meta-analysis of 64 studies reporting on 83 different valuation scenarios involving environment-related public goods, Schläpfer (2005) found that the low income effects may be an artifact of the survey method. Schläpfer, F. 2006. “Survey protocol and income effects in the contingent valuation of public goods: A meta-analysis.” *Ecological Economics* 57: 415-429.

⁶⁴ This technique has been repeatedly recognized in the literature. Alberini, A., Kanninen, B., and Carson, R.T. 1997. “Modeling Response Incentive Effects in Dichotomous Choice Contingent Valuation Data.” *Land Economics* 73(3): 309-24. Eckerlund, I., Johannesson, M., Johansson, Per-Olov., Tambour, M., Zethraeus, N. 1995. “Value for money? A contingent valuation study of the optimal size of the Swedish health care budget.” *Health Policy* 34: 135-143.

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Table 5.3 contains the elasticity calculations for both the base and scope versions of the Stratus survey. As the bid amounts increase, the percentage change in the bid amount is calculated. Similarly, the corresponding change in the percentage of respondents who vote in favor of the program (the quantity) is calculated. The comparison of these percent changes reflects the elasticity. When the bid goes up from \$10 to \$45, this represents a 350 percent price increase. However, in response to this price increase, the quantity demanded (represented by the probability of a “Yes” vote as reported by Stratus) falls only 14 percent, reflecting inelastic demand. Because all of the elasticity calculations are less than 1, the respondents’ demand for improvements to the river and lake are inelastic. This result is inconsistent with expectations based upon the extensive literature previously described. Even more troubling, in the base survey result, the demand (probability of voting “Yes”) actually increases rather than declining in response to an increase in price (the Bid price). When the bid rises from \$80 to \$125 (a 60 percent price increase) the proportion of Respondents voting “Yes” to the expenditure simultaneously increases. Such results violate accepted economic tenets.

Table 5.3: Base Questionnaire Bid Elasticity

Bid	Pr(Yes) (%)	% Change Quantity	% Change Bid	Bid Elasticity
\$10	81.5			
\$45	70.1	-14.0	350.0	-0.040
\$80	60.2	-14.1	77.8	-0.182
\$125	61.5	2.2	56.3	0.038
\$205	43.5	-29.3	64.0	-0.457
\$405	34.2	-21.4	97.6	-0.219

To more precisely examine the relationship between respondents’ income and their WTP, we divide the income distribution into quartiles and separately estimate WTP for each quartile.⁶⁵ As displayed in Table 5.4, there is no consistent positive relationship between income and WTP as theory would predict, regardless of which estimator is employed.

⁶⁵ Those respondents with coded incomes at or over \$ 99,999,999,998 are dropped from this analysis.

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Table 5.4: WTP and Confidence Intervals for Income Quartiles

	ABERS	Turnbull	Lower 95%	Upper 95%
\$60,000<y<\$600,001	\$186.11	\$173.36	\$97.73	\$248.99
\$33,000<y<\$60,000	\$181.44	\$175.68	\$110.17	\$241.20
\$18,000<y<\$33,000	\$186.94	\$183.80	\$151.82	\$215.77
\$0<y<\$18,000	\$187.14	\$166.10	\$131.75	\$200.45

The wide confidence intervals for WTP within each income quartile indicate that there is large variation in choice about the restoration project based upon respondent income. These differences in WTP by income quartile are not statistically significant. The results persists regardless of how the income distribution is disaggregated (quartiles, quintiles or sextiles), and thus is not an artifact of arbitrary income grouping. Division into quintiles does not show a consistently positive relationship between income and WTP, regardless of which estimator is used. When respondent income is divided into sextiles, those in the lowest sextile (income of less than \$13,000 per year) have the highest WTP, while those in the next sextile (income of \$13,000 to \$23,000 per year) have the lowest WTP. There is no sound theoretical basis for explaining why people would exhibit increasing tolerance to pollution as they grow wealthier and, yet, that is what the Stratus results would suggest as reported in Appendix C.

We also examined the relationship between WTP and income by estimating logit models.⁶⁶ In this model, the dependent variable is a binary representation of a vote, “1” being “Yes” and “0” being “No.” Following the Stratus report, we use a

⁶⁶ *In all cases, we employed Stratus’ logit specification to predict respondents’ votes controlling for: (1) Bid amount, (2) Log income, (3) an indicator for whether you visited Tenkiller Lake or Illinois River more than six times in the last year, (4) how important the respondent thought it was to reduce state income taxes, (5) whether the state should spend less money on pollution, (6) whether the respondent lives a greater distance than the median respondent distance, (7) how serious the respondent considers the problem to be, (8) whether the respondent thinks the alum treatment would take place without the ban, (9/10) whether the respondent thinks that natural recovery will be slower or faster than stated, (11) whether the respondent believes that alum treatment will be effective, (12) whether the respondent believed the tax would be used to clean other rivers or lakes, (13) respondents’ trust in scientists and the Oklahoma government, (14) preferred method for funding environmental programs, (15) whether respondents considered themselves “environmentalists”, (16) whether respondents felt pushed to vote for the program, (17) whether respondents paid OK state taxes, (18) whether respondents believed actual program cost would exceed the stated cost.

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jackknife bootstrap to obtain standard errors for logit coefficient estimates throughout this analysis.⁶⁷

Using the full logit model as specified in the Stratus Report, we estimate the income elasticity of “Yes” vote proportions to be 0.120 with a standard error of 0.03, evaluated at the mean of all independent variables. The positive elasticity indicates that as income increases the probability of a “yes” vote also increases. However, when we disaggregate income further, we see that the income elasticity is highly unstable. In fact, for certain income groupings income elasticity is once again *negative*, indicating that as income increases the probability of a “yes” vote for the proposed restoration program actually *decreases*. Table 5.5 reports the initial income groupings we created from wealthiest to poorest, the mean income for each of those groupings, and the estimated income elasticity of “Yes” votes at that point. Because these results are consistent for income quartiles, quintiles and sextiles, they clearly are not an artifact of arbitrary grouping.

Table 5.5: Estimated Income Elasticities by Income Groupings Using Logit Model

Grouping	Mean Income	Elasticity
Quartile	\$330,000.50	0.2002
	\$46,500.00	0.177
	\$25,500.00	-0.397
	\$9,000.00	0.158
Quintile	\$332,000.50	-0.0399
	\$53,500.00	-0.446
	\$35,000.00	0.745571
	\$21,000.00	-0.20074
Sextile	\$7,500.00	0.224
	\$335,000.50	-0.09302
	\$60,000.00	0.572
	\$41,500.00	1.51442
	\$28,000.00	-0.58784
	\$18,000.00	-0.6964
	\$6,500.00	0.160972

⁶⁷ The results reported here are equivalent to those obtained from probit specification.

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These results raise serious questions about the validity of the Stratus CV study. The basic relationship between income and WTP is an established tenet of economics, which is violated by the Stratus reported results.

5.4 Recoding of Base Survey Data

Section 4 of this report highlights many instances in which respondents did not understand the CV scenario, did not accept the “facts” presented by the interviewers, were not certain of their vote, or demonstrated inconsistencies in logic within their responses. This section describes additional analyses of the data when re-coded to address these issues. The following recoding procedures were applied:

- If respondents voted “Yes”, but also indicated that they believed the new tax revenue would be used to pay for alum treatments to clean up other rivers and lakes in Oklahoma (contrary to the survey instructions), their votes were recoded as “No”. [“Pay Other River/Lake Recode”]
- If respondents voted “Yes”, but also thought the alum treatments might occur without ban, their votes were recoded as “No”. [“Alum Without Ban Recode”]
- If respondents voted “Yes” but were unsure of their votes (moderately sure or less), their votes were recoded as “No”. [“Certainty Recode”]
- If respondents voted “Yes”, but paid no state income tax or received a full refund and thus would bear no cost for the program, their votes were recoded as “No”. [“Income Tax Recode”]
- If the respondents voted “Yes”, but thought restoration would be faster than described for the lake or the river, their votes were recoded as “No”. [“Faster – River Recode and Faster – Lake Recode”]

The number and percent of “Yes” votes that were recoded for each of these reasons is presented in Table 5.6. The number of recodes for the base survey is presented relative to the Stratus’ original dataset. The Alum Without Ban recode resulted in the smallest number of recodes, changing only 20% of the originally coded “yes” votes to “no.” Cumulatively, 519 “Yes” votes (80%) are changed to “No” votes when employing all six recodes.

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Table 5.6: Recode of "Yes" Vote For Inconsistency in Logic

Dataset	# "Yes" Votes	# Recodes	% Recoded
Stratus Original	647	0	0.00%
Recode: Alum Without Ban	517	130	20.09%
Recode: Certainty	485	162	25.04%
Recode: Faster - River	505	142	21.95%
Recode: Faster - Lake	504	143	22.10%
Recode: Pay Other River/Lake	358	289	44.67%
Recode: Income Tax	389	258	39.88%
Combined Recodes	128	519	80.22%

5.5 WTP Calculated with Recoded Data

Estimates of WTP change dramatically when the recoded data are employed. Stratus' WTP developed using the ABERS estimator was \$184.55, which was corrected to \$176.78 using the Turnbull estimator. These differences in WTP, which are statistically significant on their own, are highly sensitive to each of the data recodes described above. The results for each of the recodes are set forth in Table 5.7. Individual adjustments result in anywhere from a 15% decline in WTP estimates (Alum Without Ban) to a 44% decline (Other River/Lake). If even one of these recodes is employed, Stratus' damage estimate would correspondingly decline significantly.

Table 5.7: Turnbull WTP Estimates for Original and Recoded Data⁶⁸

Dataset	WTP Estimate	% Decline
Stratus Original	\$176.78	0.0%
Recode: Alum Without Ban	\$149.63	-15.4%
Recode: Certainty	\$126.36	-28.5%
Recode: Faster - River	\$139.51	-21.1%
Recode: Faster - Lake	\$135.95	-23.1%
Recode: Pay Other River/Lake	\$98.12	-44.5%
Recode: Income Tax	\$116.47	-34.1%
Combined Recodes	\$37.98	-78.5%

⁶⁸ The results are fundamentally the same using the ABERS estimator. See Appendix E for results using the ABERS estimator.

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Using the recoded data, we estimate WTP for the same subgroups discussed in Section 5.2 of this report. For each of these subgroups, we report both the ABERS and Turnbull estimated results for “all recodes” as well as for each of the six stand alone recodes: “alum without ban”, “certainty”, “faster – river”, “faster – lake”, “pay other river/lake”, and “income tax.” In each instance, WTP declines dramatically in response to the recoding. This demonstrates the extreme fragility of the Stratus results and their instability in light of reclassifications based upon respondent uncertainty or confusion.

Passive Versus Active Users

Dividing each dataset (into those who have previously visited the Illinois River and those who have never visited the Illinois River) confirms that active users have higher WTP than do passive users. The same conclusion holds for Tenkiller Lake. As before, WTP is consistently lower with the recoded dataset than it is with the Stratus-provided dataset, and passive users have lower WTP than active users. These differences are statistically significant for most of the recoded datasets.⁶⁹

Table 5.8 shows the estimated WTP for Active and Passive Users of the Illinois River. The first row presents WTP based on the original Stratus data, calculated with the more appropriate Turnbull estimator. The next rows apply the same procedures to the recoded data to measure how WTP changes. Employing even one of the recodes results in a lower WTP than the estimates using the original Stratus data. Recoding only those respondents who believed that the alum treatments would be done without the ban (“Alum Without Ban” recode) results in the smallest decline in WTP, which nonetheless represents a 14% to 19% decline in WTP for Active and Passive Users, respectively. Each of the other five recodes results in an even greater reduction to the WTP estimates, ranging from 18% to 46% less than the original estimate for both Passive and Active Users. The final row in the table shows the WTP for Passive Users, assuming all six recodes are employed. As this table makes clear, applying all of the recodes results in a WTP estimate between 82% and 92% lower than that estimated by Stratus.

⁶⁹ The difference was significant for Alum Without Ban, Certainly, Faster - River, Faster - Lake, and Income Tax.

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Table 5.8: Turnbull WTP Estimates for Passive and Active Users of the Illinois River⁷⁰

Dataset	Passive IL River		Active IL River	
	WTP	% Decline	WTP	% Decline
Stratus Original	\$154.21	0.0%	\$202.89	0.0%
Recode: Alum Without Ban	\$125.27	-18.8%	\$174.54	-14.0%
Recode: Certainty	\$109.43	-29.0%	\$144.16	-28.9%
Recode: Faster - River	\$109.17	-29.2%	\$109.61	-46.0%
Recode: Faster - Lake	\$107.57	-30.2%	\$165.71	-18.3%
Recode: Pay Other River/Lake	\$89.02	-42.3%	\$109.61	-46.0%
Recode: Income Tax	\$86.64	-43.8%	\$139.52	-31.2%
Combined Recodes	\$26.80	-82.6%	\$17.15	-91.5%

Table 5.9 presents similar results for Passive and Active Users of Lake Tenkiller. Once again, the “Alum Without Ban” recode results in the smallest decline in WTP when compared to the original Stratus estimates; nonetheless, it decreases WTP by between 23% for Active Users and 12% for Passive Users. Indeed, each of the individual recodes reduces the WTP estimate by between 20% and 45%. Accepting all of the recodes results in a WTP that is between 78% and 80% lower than the ABERS estimates using the original Stratus data.

Table 5.9: Turnbull WTP Estimates for Passive and Active Users of Tenkiller Lake⁷¹

Dataset	Passive Lake		Active Lake	
	Turnbull WTP	% Decline	Turnbull WTP	% Decline
Stratus Original	\$142.08	0.0%	\$135.00	0.0%
Recode: Alum Without Ban	\$112.81	-20.6%	\$138.02	2.2%
Recode: Certainty	\$103.03	-27.5%	\$148.72	10.2%
Recode: Faster - River	\$104.66	-26.3%	\$143.68	6.4%
Recode: Faster - Lake	109.81	-22.7%	-	-
Recode: Pay Other River/Lake	\$83.55	-41.2%	\$112.69	-16.5%
Recode: Income Tax	\$86.73	-39.0%	\$134.05	-0.7%
Combined Recodes	\$31.92	-77.5%	\$41.04	-69.6%

⁷⁰ The results are fundamentally the same using the ABERS estimator. See Appendix D for results using the ABERS estimator.

⁷¹ The results are fundamentally the same using the ABERS estimator. See Appendix D for results using the ABERS estimator.

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Effectiveness of Alum Treatment

As with the original data, separating the population by individual perceptions of the effectiveness of alum yields the most dramatic results. The original data reveal differences of over \$134 (57%) in the WTP of those who think the treatment will be ineffective or moderately effective and those who think the treatment will be very or extremely effective. While the disparity between the two groups is smaller in terms of a dollar amount (\$47), when expressed as a percent the disparity is larger at 84%. Table 5.10 shows the individual effects of each data recode on these two distinct subpopulations, as well as the cumulative change when all six recodes are employed. The individual recodes result in reductions to the WTP of between 15% and 60% when compared with the original Stratus estimates for the combined population. Accepting all of the recodes results in a WTP estimate that is 76% to 91% lower than the ABERS estimate produced with the original Stratus data.

Table 5.10: Turnbull WTP Estimates by Respondents' Belief in Alum Treatment Effectiveness: Not, Slightly, Moderate versus Very or Extremely⁷²

Dataset	Not/Slightly/ Moderate	% Decline	Very/ Extremely	% Decline
Stratus Original	\$100.88	0.0%	\$235.29	0.0%
Recode: Alum Without Ban	\$82.10	-18.6%	\$200.74	-14.7%
Recode: Certainty	\$43.48	-56.9%	\$181.77	-22.7%
Recode: Faster - River	\$62.49	-38.1%	\$190.37	-19.1%
Recode: Faster - Lake	\$60.34	-40.2%	\$186.58	-20.7%
Recode: Pay Other River/Lake	\$40.08	-60.3%	\$132.72	-43.6%
Recode: Income Tax	\$67.42	-33.2%	\$147.29	-37.4%
Combined Recodes	\$9.04	-91.0%	\$56.15	-76.1%

State Spending on Pollution

Using the recoded data, we also iterated the distinction between those who want to spend "less" from those who want to spend the "same" on resolving pollution problems. Combining these two subgroups, but using the recoded data, produces the following WTP estimates, which in each case, are lower than Stratus reported for the respondent population at large.

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Table 5.11: Turnbull WTP Estimates by Respondents' Belief that State Should Spend Less, or the Same on Pollution (Q7e)⁷³

Dataset	WTP Estimate	% Decline
Stratus Original	\$119.96	0.0%
Recode: Alum Without Ban	\$106.64	-11.1%
Recode: Certainty	\$86.84	-27.6%
Recode: Faster - River	\$94.20	-21.5%
Recode: Faster - Lake	\$90.79	-24.3%
Recode: Pay Other River/Lake	\$65.82	-45.1%
Recode: Income Tax	\$62.09	-48.2%
Combined Recodes	\$28.58	-76.2%

5.6 Bid and Income Elasticities Calculated with Recoded Data

As with the original data, the recoded data shows that the relationship between WTP and respondent income defies economic logic. As income increases, we would expect that WTP would similarly increase, rather than decline. In other words, as in the non-segmented base survey, there is no monotonic relationship between WTP and income. In Table 5.12, we show WTP per income quartile calculated with the recoded data, where "1" represents the highest income quartile and "4" represents the lowest income quartile. Instead of WTP increasing as income increases, WTP increases as income falls with the recoded data. The WTP for the lowest income quartile is \$60.56 in the recoded dataset for both the ABERS and Turnbull estimates. In contrast, WTP for the highest income quartile was only \$11.46 and \$3.05 for the ABERS and Turnbull estimates, respectively. This means that the lowest income group was willing to pay more than five times the amount of the highest income group when the ABERS estimator is employed, or more than 19 times when the Turnbull estimator is used. These results defy economic logic and suggest the infirmity of the Stratus results.

⁷² The results are fundamentally the same using the ABERS estimator. See Appendix D for results using the ABERS estimator.

⁷³ The results are fundamentally the same using the ABERS estimator. See Appendix D for results using the ABERS estimator.

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Table 5.12: Willingness-to-Pay by Income Quartile for Recoded Data

Income Quartile	ABERS		Turnbull	
	Original	Recoded	Original	Recoded
4 (lowest)	\$187.14	\$60.56	\$166.10	\$60.56
3 (low mid)	\$186.94	\$55.51	\$183.80	\$34.27
2 (high mid)	\$181.44	\$27.21	\$175.68	\$13.50
1 (highest)	\$186.11	\$11.46	\$173.36	\$3.05

In parallel to our elasticity calculations for the base survey, we estimate income elasticities at the mean income for the quartile income groupings. Recall that if the probability of a “yes” vote increases as income rises, then income elasticity will be positive. As found in the base data, although income elasticity is positive for the entire population, when calculated by income groupings, it is not consistently positively related to the probability of voting “Yes.”⁷⁴ As shown in Table 5.13 for the third quartile of the recoded data, an increase in income is associated with a decrease in the probability of a “yes” vote. Again, these results are inconsistent with economic principles.

Table 5.13: Income Elasticities by Income Quartile

Quartile	Max Income	Original Stratus	Recoded Data
4 (lowest)	\$18,000	0.158	0.37
3 (low mid)	\$33,000	-0.397	0.07
2 (high mid)	\$60,000	0.177	3.576
1 (highest)	\$600,001	0.2	5.713

Finally, we reviewed the bid elasticities for the recoded data. Recall that the bid amount was not negatively related to the probability of voting “Yes” in the original data. In other words, for the bid amount of \$125, the probability did not decline. For the recoded data, in contrast to the base data, the bid elasticities are now negative at each point. This is more consistent with fundamental economic principles than the results obtained for the base data in the Stratus report. Table 5.14 shows the base bid elasticities for the original Stratus dataset and the recoded datasets.

⁷⁴ Elasticities for income quintiles and sextiles are included in Appendix E to demonstrate that this phenomenon is not isolated to income quartiles.

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Table 5.14: Bid Elasticities Calculated with Recoded Data

Bid	Bid Elasticity	
	Stratus Data	Recoded Data
\$10		
\$45	-0.04	0.00
\$80	-0.18	-0.51
\$125	0.04	-0.14
\$205	-0.46	-0.30
\$405	-0.22	-0.25

5.7 Results of Scope Test with Recoded Data

Finally, as previously discussed, the effectiveness of the scope test was evaluated using the data as originally coded by Stratus. Using the recoded data, the probability of voting “yes” continues to be much higher for the base survey than for the scope survey. Similarly, estimates of WTP as set forth in Table 5.15 are significantly lower for the recoded data when compared to the original Stratus data.

Table 5.15: Probability of Voting Yes and WTP Estimated With Recoded Data

	Pr(Yes)		ABERS		Turnbull	
	Base	Scope	Base	Scope	Base	Scope
Stratus	0.58	0.42	\$184.55	\$138.51	\$176.78	\$138.51
Recoded	0.13	0.07	\$37.98	\$24.31	\$37.98	\$6.29

As another comparison between the base and scope surveys, we examined bid elasticities with the results set forth in Table 5.16.

Table 5.16: Bid Elasticities – Stratus vs. Recoded Data

Bid	Main		Scope	
	Stratus Data	Recoded Data	Stratus Data	Recoded Data
\$10				
\$45	-0.040	-0.001	-0.092	-0.115
\$80	-0.183	-0.507	-0.172	-0.924
\$125	0.039	-0.143	-0.111	1.891
\$205	-0.456	-0.298	-0.304	1.708
\$405	-0.221	-0.247	-0.082	-0.478

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As with the original Stratus data, the sign for the recoded data changes with the scope survey results. However, in this case, the sign changes and becomes positive for bids of both \$125 and \$205. This is inconsistent with economic theory, which implies that the all the bid elasticities should be negative. In particular, this result points to large differences in the way people react to bids in the base survey versus the scope test.

To test the validity of our recoded dataset, we administered the same scope analysis employed by Stratus' economic experts on our recoded base and recoded scope data. The econometric tools they used to validate the scope test included an F-test and a logistic regression model. The F-test yields a measure of association and examines the likelihood that voting "yes" is related to being in the base versus the scope study. The logistic regression is used to generate predictions of voting behavior for scope and base participants, conditioning on individual characteristics and a distinguishing variable for whether the respondent was given the scope or base scenario. Our replications of these analyses for recoded datasets corroborate their findings: we find from the F-test that there is a relationship between voting "yes" and being in the base versus the scope study, and we find from the logistic regression that there is a statistically significant, positive effect of the base scenario on the prediction of voting "yes".

The percentage of people who voted "Yes" at each bid are given in Table 5.17 below.

Table 5.17: Recoded Scope Test – Percent of "Yes" Votes

Bid Amount	Recoded base	Recoded scope
\$10	19.44%	13.87%
\$45	19.40%	8.29%
\$80	11.73%	2.30%
\$125	10.80%	4.78%
\$205	8.73%	10.03%
\$405	6.65%	5.37%

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5.8 Implications of Pre-Test Survey Data

There is a clear difference in the injury scenario proposed in the pre-tests Stratus conducted and their final base survey. Qualitatively, the injury attributed to phosphorus is far smaller for the base survey than it is in the pre-tests (see Table 5.18). For example, in the first four pre-tests, fish kills were mentioned, the description of algae was extensive, and the extent of fish injury was also extensive. In contrast, the final base survey did not mention fish kills and had a moderate description of algae and moderate fish injury. Table 5.18 shows the bid amounts, including the probability of a “yes” vote for the highest bid, as well as several survey attributes such as the payment vehicle (e.g., tax paid each year for five years versus a onetime tax added to state income tax bill), whether or not the vote was given via a ballot, as well as various measures of injury.

**Table 5.18a: Comparison of Pre-Test Surveys
and Stratus Main Survey (Bid Amounts)**

Component	Jan. 13, 2008	Feb. 4, 2008	Feb. 6, 2008	Pilot 1	Pilot 2	FG 14	Final Base Survey
<i>BidAmount</i>							
10				√	√	√	√
30				√			
45							√
55					√		
60	√	√	√				
65				√		√	
80							√
95					√		
105						√	
115				√			
125							√
150	√	√	√				
155					√		
205							√
245				√			
250	√	√					
375					√		
405							√
500			√				

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**Table 5.18b: Comparison of Pre-Test Surveys
and Stratus Main Survey (Scenario)**

Component	Jan. 13, 2008	Feb. 4, 2008	Feb. 6, 2008	Pilot 1	Pilot 2	FG 14	Final Base Survey
<i>Payment Vehicle</i>	Pay tax each year for 5 years	Pay tax each year for 5 years	Pay tax each year for 5 years	Pay tax each year for 5 years	One time tax added to state income tax bill	One time tax added to state income tax bill	One time tax added to state income tax bill
<i>Ballot Envelope</i>	Yes	Yes	Yes	No	No	Yes	No
Fish kills mentioned	Yes	Yes	Yes	Yes	No	No	No
Extent of algae description	Extensive	Extensive	Extensive	Extensive	Moderate	Moderate	Moderate
Types of fish injuries	Extensive	Extensive	Extensive	Extensive	Moderate	Moderate	Moderate
<i>Baseline Years</i>	1960	1960	1960s	1960s	Around 1960	Around 1960	Late 1950s, early 1960s
<i>Restoration Years</i>	River: 50 years	50 years (present with alum 1st at 10 years)	50 years (present with alum 1st at 10 years)	50 years (present with alum 1st at 10 years)	50 years (present with alum 1st at 10 years)	50 years (present with alum 1st at 10 years)	50 years (present with alum 1st at 10 years)
	Lake: 70 years	60 years (present with alum 1st at 20 years)	60 years (present with alum 1st at 20 years)	60 years (present with alum 1st at 20 years)	60 years (present with alum 1st at 20 years)	60 years (present with alum 1st at 20 years)	60 years (present with alum 1st at 20 years)

Despite the smaller injury in the final base survey, the resulting Turnbull WTP estimates show a *higher* WTP, contradicting economic theory. The WTP estimates shown below in Table 5.19 are clearly lower for every pre-test dataset than they are for the final base survey dataset. All but the base surveys conducted on February 6 and for Pilot 2 are lower than the scope version of the final dataset. This suggests that Stratus “improved” its results through ongoing survey design.

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Table 5.19: Comparison of WTP and Income Elasticities for Pre-Test Surveys and Stratus Main Survey

Pre-Test Dataset	# of Participants	Turnbull	Difference between base & scope WTP	Income Elasticity (Below median)	Income Elasticity (Above median)
Jan 13, Base	43	\$96.93			
Jan 13, Scope	37	\$81.60	-15.80%	-55.36	0.01
Feb 4, Base	59	\$85.36		62.23	22.46
Feb 4, Scope	56	\$29.12	-65.90%		
Feb 6, Base	100	\$153.77		46.74	-0.61
Feb 6, Scope	92	\$118.01	-23.30%	1.30	
FG14, Base	94	\$49.77		0.03	0.27
FG14, Scope	97	\$22.75	-54.30%	1.54	
Pilot 1 (Base only)	152	\$128.90	n/a	0.23	0.13
Pilot 2 (Base only)	152	\$173.51	n/a	0.12	0.08
Final, Base	1,093	\$176.78		0.00	0.00
Final, Scope	544	\$138.51	-21.60%	-0.001	-0.006

We also find no consistent relationship between income and WTP using the logit specification provided in the Stratus report. We divide household incomes into two groups, below and above the median household income of each set of respondents, and report the income elasticity calculated for each group. None of the elasticity estimates is statistically significant, indicating that there may be no relationship between household income and response. This runs counter to simple economic logic and prior studies regarding WTP for preserving or improving environmental resources.

The comparison of pre-test and final survey results also highlights the serious problem inherent in contingent valuation based on bid structure. Since nonparametric WTP estimators use weighted averages of the bids, any bid above \$405 added to the bid structure would have increased the mean WTP in all cases, unless the bid was so high that no respondents would accept it. However, we are aware of no CV studies with a significant nonuse component where the authors have offered a bid high enough that the number of “yes” responses approaches zero. With the evidence that some respondents will say “yes” to almost any bid,⁷⁵ it is possible to predetermine the mean

⁷⁵ Carson, et al. (1992) study the Exxon Valdez oil spill and find 34% of respondents say “yes” at \$120. Carson, et al. (1996) study the Southern California Bight and find that 25% say “yes” at \$215. Brown, et al. (1996) study the Grand Canyon and find 33% say “yes” at \$50. Desvousges, et al. (1993) study of oil-spill response finds 30%-38% say “yes” at \$1,000. McFadden and Leonard (1993) study the Selway wilderness area and find 26 % say “yes” at \$2,000.

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WTP just by the selection of the highest bid. This frequent phenomenon in contingent valuation has been interpreted as indicating “yea-saying” responses. Yea-saying artificially increases the proportion of people who respond “yes” at any given bid, magnifying the resulting hypothetical bias.

Focusing our attention on the base survey, we see that 34.17% of respondents offered the highest bid of \$405 responded “yes.” Because the CV survey only allows “yes” or “no” answers, there is very little information about the nature of the true WTP for these respondents. Testing for the sensitivity of estimated WTP to yea-saying, we assume that everyone who said “yes” to this bid either has an outlier WTP or would have responded “no” given more time to dwell on their preferences. With this assumption, we estimate a Turnbull WTP of \$108.42, with a 95% confidence interval of \$93.76 to \$123.08. This represents a decrease of 38.67% from the Turnbull WTP of \$176.78, estimated from the base survey and assuming no degree of nay-saying. With this extreme sensitivity, the authors must provide some serious justification for their implicit assumption of yea-saying not causing substantive hypothetical biases.

5.9 References

- Alberini, A., Rosato, P., Longo, A., Zanatta, V. 2004. “Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice.” *Nota Di Lavoro* 19.2004.
- Bateman, I.J., and Langford, I.H. 1997. “Non-users’ Willingness to Pay for a National Park: An Application and Critique of the Contingent Valuation Method.” *Regional Studies* 31.6: 571-582.
- Brown, Thomas C., Patricia A. Champ, Richard C. Bishop and Daniel W. McCollum. 1996. “Which Response Format Reveals the Truth about Donations to a Public Good?” *Land Economics* 72(2): pp.152-166.
- Carson, Richard T, Robert C. Mitchell, Michael Hanemann, Raymond J. Kopp, Stanley Presser, and Paul A. Ruud. 2003. “Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill.” *Environmental and Resource Economics* 25(3): 157-286.
- Carson, Richard T., Michael B. Conaway, W. Michael Hanemann, Jon A. Krosnick, Kerry M. Martin, Donald R. McCubbin, Robert Cameron Mitchell, and Stanley Presser. 1996. *The Value of Preventing Oil Spills to Natural Resources Along California’s Central Coast*. Report prepared for the California Department of Justice, the Office of Oil Spill Prevention and Response in the California

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Department of Fish and Game, and the Damage Assessment Center of the National Oceanic and Atmospheric Administration. San Diego, CA: Natural Resource Damage Assessment, Inc.

Desvousges, William H., F. Reed Johnson, Richard W. Dunford, Kevin J. Boyle, Sara P. Hudson, and K. Nicole Wilson. 1993. "Measuring Natural Resource Damages With Contingent Valuation: Tests of Validity and Reliability." In *Contingent Valuation: A Critical Assessment*, Jerry A. Hausman, ed. Amsterdam: Elsevier Science Publishers B.V.

Fisher, T.C.G., and Waschik, R.G. 2002. "Chapter 11: Government regulation of industries." In *Managerial Economics: A Game Theoretic Approach*. Lodong, New York: Routledge.

Haab, Timothy C. and Kenneth E. McConnell. 2003. *Valuing Environmental and Natural Resources: The Econometrics of Non-market Valuation*. Edward Elgar Publishing.

Jacobsen, B.R., and Hanley, N. 2008. "Are there income effects on global willingness to pay for biodiversity conservation?" Submitted to *Environmental and Resource Economics*.

Kriström, Bengt and Pere Riera. 1996. "Is the Income Elasticity of Environmental Improvements Less Than One?" *Environmental and Resource Economics* 7(1) 45-55.

Le Goffe, Ph. 1995. "The Benefits of Improvements in Coastal Water Quality: A Contingent Approach," *Journal of Environmental Management* 45: 305-317

McFadden, Daniel, and Gregory K. Leonard. 1993. "Issues in the Contingent Valuation of Environmental Goods: Methodologies for Data Collection and Analysis." In *Contingent Valuation: A Critical Assessment*, J. A. Hausman, ed. Amsterdam: Elsevier Science Publishers B.V.

Organisation for Economic Co-operation and Development. 2001. *OECD Environmental Outlook*, OECD Publishing.

Scheierling, S. M., J. B. Loomis, and R. A. Young. 2006. "Irrigation water demand: A meta-analysis of price elasticities." *Water Resour. Res.* 42.

Schläpfer, F., "Survey protocol and income effects in the contingent valuation of public goods: A meta-analysis," *Ecological Economics* 57 (2006): 415-429.

Soderqvist, Tore, and Therese Lindahl. 2003. "Wetland Creation: Socio-Economic and Institutional Conditions for Collective Action." In *Managing wetlands: An ecological economics approach*, Turner, R. Kelly, van-den-Bergh, Jeroen C. J.M., Brouwer, Roy, eds. Cheltenham, UK and Northampton, Mass, pp: 223-49.

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6. AGGREGATION OF DAMAGES

To aggregate future damages, the plaintiffs' experts multiply the resulting WTP from the CV survey by the number of households in the counties sampled during the survey process. This aggregation essentially assumes that all households in the 63 counties hold either (or both) use values or nonuse values for the aesthetics of the Illinois River System and Tenkiller Lake. However, from an economic perspective, this number of affected households is an unproven assertion advanced by the plaintiffs' experts.

The economics literature has long recognized that only some individuals or households have economic standing with respect to the quantification of societal benefits (Whittington and MacRae 1986). However, at the time of the NOAA Panel report, the issue of "who counts" had not yet been raised by economists. Subsequent to the NOAA Panel, Smith (1993) and Dunford, Johnson, and West (1997) extend the logic of economic standing to recreation services provided by natural resource services, revealing that who counts is not a foregone conclusion from an economic perspective. For use values, observed behaviors guide the determination of the extent of the market.

With respect to nonuse values (or total values because they include nonuse values), reliance on geopolitical boundaries results in an arbitrary and unsupported determination of who counts. This arises because "no simple rules define who holds these values" (Bateman 2000). Thus, the convenience of using geopolitical boundaries results in inaccurate damage estimates. Hanley, Schläpfer, and Spurgeon (2003) conclude that:

"[e]rrors made in estimating the number of users and non-users effected [sic] by an environmental change can easily swamp errors in estimates of per-person Willingness to Pay (WTP) when aggregate values are calculated" (p. 297).

Bateman, et al. (2006) provide other empirical examples of the overestimates produced by reliance on the geopolitical boundaries.

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From an economic perspective, having standing for nonuse damages requires that an individual be in a position to experience an economic welfare loss from a specific natural resource injury. Thus, logically, the natural resource service must be a component of the individual's utility or well-being. If that individual has no knowledge of a natural resource, then it cannot affect his or her well-being. Knowledge of a natural resource is thus a necessary, but not sufficient, condition for a welfare loss. As noted earlier, the CV survey respondents' awareness of water quality was created within the Stratus survey and was based on biased and misleading information. This further limits the ability to draw any kind of scientific conclusion about what other households in Oklahoma would have thought about water quality in the Illinois River System and Tenkiller Lake.

In addition, the individual must perceive a difference in the quality (or quantity) of a natural resource service in order to experience an economic welfare loss. Bockstael, et al. (2000) emphasize that measuring the value of a natural resources depends is relative to current conditions. Thus, noticing a change in the resource satisfies both the necessary and sufficient conditions.

Johnson, et al. (2001) develop a conceptual model for nonuse values that establishes the roles of knowledge and awareness. Their theoretical model follows the work of Kaldor and Hicks and relies upon the well-established economic principle of Pareto improvement for welfare measurements. They measure knowledge of a distressed river system in the Northeastern United States by conducting a knowledge survey of households within 400 miles of the river. Like the 2006 survey work by Stratus, they ask about respondents' knowledge without prompting them or informing them. Their case study demonstrates that within the state boundaries, less than 50 percent of the households within the state had knowledge of the river. When evaluating the awareness criterion of households surveyed, even fewer households (about 15 percent) were aware of the environmental changes. Thus, state residency is not a reliable proxy for knowledge or awareness of the resource, further reducing any rationale for the Stratus decision to multiply their survey results by the number of households in most of Oklahoma.

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The Stratus CV survey does not provide the opportunity to assess knowledge or awareness separate from the information provided by the interviewer. Respondents are first told that the Illinois River is a scenic river. After being told that it is a scenic river, about one-third of the respondents claim that they knew about its scenic status prior to the interview. Similarly, respondents are also told about the alleged algae conditions. After being told by the interviewers that water clarity is worse now than it was in 1960, about one-third of the respondents claim that they had prior knowledge of the change. Following the lead of Carson, et al. (1994), the Stratus CV survey “constructs” nonuse values. Kontoleon, Macrory, and Swanson (2002) state in regard to the construction of nonuse values:

“Respondents in CV studies that have not (endogenously) acquired such information nevertheless receive (exogenous) information from the study itself...The usefulness of the estimated values from such individuals for damage assessment is questionable. [Nonuse values] do not exist independent of individual perception. Hence, losses in nonuse values require some prior knowledge” (pp. 197-198).

Thus, the combination of nonresponse bias in the CV survey results, the inability to of the CV survey to demonstrate prior knowledge of the affected resources, and the lack of any empirical rationale for the number of affected households renders the Stratus estimate of the number of households invalid. Given that this number is a large part of the total damage estimate generated by Stratus, the total estimate itself is invalid.

6.1 References

- Bateman, I.J., B.H. Daya, S. Georgioua, and I. Lake. 2006. “The Aggregation of Environmental Benefit Values: Welfare Measures, Distance Decay and Total WTP.” *Ecological Economics* 60: 450–60.
- Bateman, Ian J., Andrew P. Jones, Naohito Nishikawa, and Roy Brouwer. 2000. “Benefits Transfer in Theory and Practice: A Review.” CSERGE Working Paper GEC 2000-25. Bishop0000339_Bateman.et.al.2000pdf.pdf.
- Bockstael, Nancy E., A. Myrick Freeman, III, Raymond J. Kopp, Paul R. Portney, and V. Kerry Smith. 2000. “On Measuring Economic Values for Nature.” *Environmental Science and Technology*. 34(8): 1384-1389.

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- Carson, Richard T., W. Michael Hanemann, Raymond J. Kopp, Jon A. Krosnick, Robert C. Mitchell, Stanley Presser, Paul A. Ruud, and V. Kerry Smith. 1994. *Prospective Interim Lost Use Value Due to DDT and PCB Contamination in the Southern California Bight*. Report prepared for the National Oceanic and Atmospheric Administration. La Jolla, CA: Natural Resource Damage Assessment, Inc. September 30.
- Dunford, R. W., Johnson, F. R., and West, E. S. 1997. "Whose Losses Count In Natural Resources Damages?" *Contemporary Economic Policy* 15(4): 77(11).
- Hanley, N., F. Schläpfer, and J. Spurgeon. 2003. Aggregating the Benefits of Environmental Improvements: Distance-Decay Functions for Use and Non-use Values. *Journal of Environmental Management* 68: 297–304.
- Johnson, R.F., R.W. Dunford, W.H. Desvousges, and M.R. Banzhaf. 2001. The Role of Knowledge in Assessing Nonuse Damages: a Case Study of the Lower Passaic River. *Growth and Change* 32: 43–68.
- Kontoleon, Andreas, Richard Macrory, and Timothy Swanson. "Individual preference-based values and environmental decision making: should valuation have its day in court?" *Research in Law and Economics* 20:179–216.
- Smith, V.K. 1993. "Welfare Effects, Omitted Variables, and the Extent of the Market." *Land Economics* 69(2): 121–31.
- Whittington, D. and D. MacRae, Jr. 1986. "The issue of standing in cost-benefit analysis." *Journal of Policy Analysis and Management* 5:665.

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7. CRITIQUE OF PAST DAMAGES STUDY

The damage estimate from the Stratus CV study addresses only the alleged future losses in services provided by the Illinois River System and Tenkiller Lake. The damage estimate from the Stratus CV survey does not represent alleged past losses in services provided by the lake and river system. In order to generate additional damages that reflect the alleged past losses in services, the Stratus team pro-rates the WTP results from the CV survey and applies that pro-rated amount to past years (1981 to 2008). This section discusses the serious flaws with that approach, which render the estimate of past damages unreliable.

7.1 The methodology is not consistent with a benefits-transfer approach.

Stratus presents its pro-rating process as a benefits-transfer. A benefits-transfer, as customarily discussed in the literature, uses existing WTP results, based on an original data from one geographic area, and applies them to another geographic area. These transfers are most often used in policy applications, where collecting original data is not financially feasible. The literature on benefits transfer also clearly notes the limitations of the method. For example, for valuing ecosystem services, such as those purportedly measured by the Stratus CV survey, the National Research Council (NRC) (2005) indicated that “benefits transfer is generally considered a “second best” valuation approach by economists” (p.124). The NRC adds that such transfer should be viewed with caution and done according to strict guidelines. Smith (1996) indicates that we have not done much research on benefits transfer, and instead have merely performed such transfers.

The existing literature demonstrates the notion that a benefits-transfer is a spatial concept. For example, the seminal studies on benefits-transfer published in the early 1990s reveal an explicit focus on transferring WTP from a “study site” to a “policy site” (Brookshire and Neill 1992; Smith 1992; Desvousges, Naughton, and Parsons 1992; McConnell 1992; Boyle and Bergstrom 1992). More recent literature confirms the defining spatial feature (Desvousges, Johnson, and Banzhaf 1998; EVRI). For example, Zandersen, Termansen, and Jensen (2007) offer the following definition:

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“Benefits transfers are based on sites where monetary valuation has already been carried out (policy sites) and transferred to new, unstudied sites (study sites)...Benefit transfers have traditionally been carried out over space from one geographical location to another” (p. 412).

Because the Stratus approach is not consistent with the established literature on benefits-transfer, the methodology used by Stratus is neither well-established nor generally accepted by the economics profession.

7.2 Applying values backwards in time is not reliable.

To our knowledge, the literature on benefits transfer contains no references to studies that extrapolate damages backward in time. In fact, only a handful of studies have evaluated the temporal aspects of applying WTP forward in time, and none of these studies concludes that doing so provides reliable estimates of WTP. Loomis (1989) finds evidence that WTP values may be relatively stable over short periods of time (nine months) when the determinants of WTP stay constant. Downing and Ozuna (1996) investigate the reliability of applying WTP values three years in the future. They conclude that applying values over time is not reliable. Zandersen, Termansen, and Jensen (2007) test the accuracy of a forward application of recreational values over a period of 20 years for 52 forests in Denmark. They find error rates ranging from 25 to nearly 300 percent over the 20-year span.

In contrast to this handful of studies, none of which concludes that a forward application is reliable, the Stratus methodology take a current WTP estimates and applies it **backwards** for 28 years. There is no literature to support the reliability of either the backwards application or the length of time. As the above literature shows, even when forecast for periods as short as a few years, the results have not been reliable. Accordingly, the Stratus methodology, which is forecast backwards for more than twenty five years, is not reliable.

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7.3 Stratus fails to demonstrate that preferences for improved water quality are constant.

One reason that the temporal application of WTP estimates is not reliable is because the preferences that govern true WTP values are not constant. Preferences for natural resource services conform to economic principles. (See Smith, Van Houtven, and Pattanayak 1999.) They will reflect the dynamic nature of the quantity and quality of substitute services, as well as budget constraints. Because these features change over time, preferences change over time. Thus, WTP values should not be expected to be constant over time.

In an attempt to address this point, Stratus relies on results from the General Social Survey (GSS). This survey has been conducted annually for decades and evaluates social trends. Since the 1970s, the survey has asked two questions about environmental spending. Stratus reviews responses to these questions over time and concludes that there has been “no material change in attitudes towards spending on the environment” between 1980 and the present. Based on this survey, Stratus proceeds with its backwards application of WTP values.

This logic is flawed for at least two reasons. First, the population surveyed in the GSS study encompasses three states beyond Oklahoma: Arkansas, Louisiana, and Texas. The sheer size of Texas will dominate the GSS results. Specifically, Texas has at least four times the number of households that Oklahoma has (US Census 2009). Although the GSS survey may accurately reflect the environmental spending preferences of the four-state region, Stratus cannot demonstrate that it reflects the preferences for 63 Oklahoma counties.

In addition, according to the construct validity model developed by Stratus in its CV report, attitudes on environmental spending is only one of a myriad of beliefs and opinions that may have influenced how the CV respondents voted. Primary influences included a number of study-specific opinions and beliefs, such as the speed of natural recovery, the seriousness of the algae issue,⁷⁶ the effectiveness of the alum program,

⁷⁶ Specifically, Stratus' own 2006 telephone survey (see Section 2 above) demonstrates that in 2006 only a small percentage of Oklahoma residents would agree that the algae was a serious issue.

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the expectations about the cost of the alum program, and many others. Without demonstrating that all of these opinions and beliefs have been constant from 1980 to 2008, Stratus cannot reliably apply the WTP estimates from the CV survey backwards in time. They offer little or evidence to support either of these critical assumptions.

Finally, it is important to consider that the GSS survey asks people only about a general attitude toward the environment. Such a general attitude is likely to have little predictive ability in explaining people's actual trade-offs that would have made over the twenty year period. It does not present provide any indication that people in the 1980's would actually have spent the same on improving the environment as people today. Nor does it provide any specific support to the potential reliability of the estimates in the Stratus CV survey.

7.4 The approach is not sufficiently reliable for litigation.

Even if the Stratus methodology were a benefits-transfer, which it is not, the literature reveals that benefits-transfer is not sufficiently reliable for litigation purposes. Brouwer and Spaninks (1999) provide "a disappointing result of how [benefit-transfer] fails even when study sites are close and the environmental good is identical" (Bishop undated). The authors compare the findings of two CV studies carried out in the Netherlands shortly after each other with regard to agricultural wildlife management on Dutch peat meadow land. Both studies concentrated on the same type of environmental good in similar areas. However, when transferring WTP from one site to another, the authors rejected the validity of transferring benefit functions.

Finally, the literature reveals the professional judgment of natural resource economists that it is not sufficiently reliable for litigation. For example, Bergstrom and Taylor (2006) state that benefits-transfer may be sufficiently accurate "for applications requiring low to moderate accuracy (e.g., screening, minor policy decisions). For applications requiring moderate to high accuracy (e.g., litigation, major policy decisions), primary data studies will probably still be preferred" (p. 359). Bergstrom and De Civita (1999) note several errors that arise with benefits transfer and reveal that "if benefits transfer is used as a basis for determining just compensation in the context of

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natural resource damage litigation, the costs of a wrong decision to individuals and society could be quite high” (p. 83). Navrud (2001) notes that errors associated with uncertainty in benefits transfer can be quite large. He contends that benefits transfer should be applied to uses of environmental valuation where the demand for accuracy is not too high. “More caution should be exercised in using transferred values... in natural resource damage assessments” (p. 72).

7.5 The Past Damages report is not based on a valid study.

Even if the Stratus methodology were a benefits-transfer, which it is not, it fails to meet on the long-established criteria for a valid transfer. Scientific soundness refers to the overall quality of a study and is widely recognized as a primary criterion for applying the results from one study to another situation (Brookshire and Neill 1992; Smith 1992; Desvousges, Naughton, and Parsons 1992; McConnell 1992; Boyle and Bergstrom 1992; Desvousges, Johnson, and Banzhaf 1998; EPA 2000). The quality encompasses all aspects of a study, such as the data, the methodology, the survey protocols, and the analysis technique. This criterion effectively asks whether the original study is sufficiently sound science. If the results were not based on reliable data, rigorous protocols, and valid analyses, then the results are not reliable and should not be used in a benefits transfer.

The past damages monetary claim made by the plaintiffs depends critically on the Stratus CV Survey. Sections 4 and 5 of this report documents the extent of hypothetical bias, nonresponse bias, the lack of balance in the survey questionnaire, the absence of validity in the CV results, and the consistent upward bias in the estimation protocols. For all of the reasons documented above, the Stratus CV results are not scientifically valid. Therefore, the benefits transfer of the CV results to past damages renders the past damages estimate invalid and unreliable.

7.6 The Past Damages report relies on faulty scientific assumptions.

The validity of certain scientific opinions enters into the calculation of the past damages. Because the scientists working for the plaintiffs believe that the average annual injury is comparable between 1981-2008 and 2009-2063, the Stratus team pro-

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rates the CV results to the number of past years. However, an important implicit assumption in this pro-rating scheme is that the presence of the poultry industry has been constant since 1981. On the contrary, the inventory of meat-type chickens in the relevant Oklahoma counties in 2007 was twice the inventory in 1987. (See Census of Agriculture 1987,1992,1997,2002, and 2007.) Moreover, the Stratus analysis fails to account for changes in water quality conditions in watershed since 1981 that are influenced by population growth and the associated impacts on water quality through increased numbers of septic systems and more waste water treatment plants, among other factors. The failure to account for other factors means that the Stratus approach to estimating past damages results in an overstatement of past damages.

7.7 The Past Damages assumptions about compound interest are flawed.

Compound interest plays a crucial role in the Stratus past damages calculations. Specifically, of the total past damages demand, nearly two-thirds of it is attributable to compound interest. As economists and not lawyers, we do comment on whether it is within the court's discretion to award compound interest in legal matters. However, we note that awarding compound interest in this case does not reflect actual funds that were lost from the State's coffers. The damages claimed by plaintiffs' consist largely of respondents' nonuse, or passive use values for a hypothetical restoration program that is neither safe nor effective and to prevent a highly biased set of injuries. Moreover, the earlier Stratus study results from actual users depicted a very different picture of water quality in the Illinois River and Tenkiller Lake. Thus, these purported losses were not experienced by people who necessarily have visited the area—in fact, half have not. These purported losses are not based on the loss of some type of productive asset that the citizens could have invested to earn interest. Thus, there is no economic basis to award compound interest for these hypothetical losses.⁷⁷

7.8 References

Bergstrom, J. C. and L. O. Taylor. 2006. "Using meta-analysis for benefits transfer: Theory and practice." *Ecological Economics* 60(2): 351-360.

⁷⁷ CVs for William H. Desvousges, Ph.D. and Gordon C. Rausser, Ph.D. are in Appendix F.

March 31, 2009

Bergstrom, J. and P. De Civita. 1999. "Status of benefits transfer in the United States and Canada: A review." *Canadian Journal of Agricultural Economics* 47(1): 79-87.

Bishop undated. Bishop0000312_Benefit.Transfer.review_04-21_eh.doc

Boyle, K.J., and J.C. Bergstrom. 1992. "Benefit Transfer Studies: Myths, Pragmatism, and Idealism." *Water Resources Research* 28(3):657-663.

Brookshire, D.S., and H.R. Neill. 1992. "Benefit Transfers: Conceptual and Empirical Issues." *Water Resources Research* 28(3):651-655.

Brouwer, R. and F. Spaninks. 1999. "The validity of transferring environmental benefits: Further empirical testing." *Environmental and Resource Economics* 14(1): 95-117.

Desvousges, W.H., F.R. Johnson, and H.S. Banzhaf. 1998. *Environmental Policy Analysis With Limited Information: Principles and Applications to the Transfer Method*. Cheltenham, UK: Edward Elgar.

Desvousges, W.H., M.C. Naughton, and G.R. Parsons. 1992. "Benefit Transfer: Conceptual Problems in Estimating Water Quality Benefits Using Existing Studies." *Water Resources Research* 28(3):675-683.

Downing, M. and T. Ozuna. 1996. "Testing the Reliability of the Benefit Function Transfer Approach." *Journal of Environmental Economics and Management* 30(3): 316-22.

Environmental Valuation Reference Inventory. <http://www.evri.ca/>

Loomis, John B. 1989. "Test-retest Reliability of the Contingent Valuation Method: A Comparison of General Population and Visitor Responses." *American Journal of Agricultural Economics* 1: 76-84.

McConnell, K.E. 1992. "Model Building and Judgment: Implications for Benefit Transfers with Travel Cost Models." *Water Resources Research* 28(3):695-700.

National Research Council. 2005. *Valuing Ecosystem Services Toward Better Environmental Decision-Making*. The National Academies Press. Washington, D.C.

Navrud, S. 2001. "Comparing valuation exercises in Europe and the United States – challenges for benefit transfer and some policy implications." In: *Valuation of Biodiversity Benefits: Selected Studies*. Biller, D. and Bark, R. (eds). OECD, Paris, pp. 63-77.

Smith, V.K., Van Houtven, G., Pattanatak, S. 1999. "Benefit Transfer as Preference Calibration." *Resources for the Future*, Discussion Paper 99-36.

March 31, 2009

Smith, V.K. 1992. "On Separating Defensible Benefit Transfers from Smoke and Mirrors." *Water Resources Research* 28(3):685–694.

U.S. Census Bureau. 2009. "QuickFacts." Accessed March 11, 2009.

U.S. Census of Agriculture. 1987,1992,1997,2002 and 2007

U.S. Environmental Protection Agency. 2000. *Guidelines for Preparing Economic Analyses*. Report Number 240-R-00-003. Washington, DC: USEPA. September.

Zandersen. M., Termansen, M. and F. S. Jensen. 2007. "Testing benefits transfer of forest recreation values over a twenty-year time horizon." *Land Economics* 83(3): 412-440.

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Appendix A
Literature Review On Hypothetical Bias

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The Empirical Literature Confirms Hypothetical Bias in CV Results

To evaluate how the hypothetical nature of the questions affects CV results, researchers have performed several experiments to test for hypothetical bias. Generally, these studies find hypothetical bias. Vossler, et al. (2003) reveal that a majority of the studies find significant response differences in hypothetical and real situations. Murphy and Stevens (2004) note that the literature shows hypothetical bias across a wide variety of CV approaches. Johnston (2006) concurs: "Most research finds significant divergence between stated and actual behaviors" (p. 469).

Following Vossler and Kerkvliet (2003), these studies fall into four groups. The first group of studies tested the difference between actual payments for private goods and stated CV payments for the same private goods (Bishop and Heberlein 1979; Dickie, Fisher, and Gerking 1987; List and Shogren 1998; Cummings, Harrison, and Rutström 1995; Berrens and Adams 1998). The second group of studies evaluated the difference in stated CV payment and revealed actual WTP for public goods for which observed behaviors are available (Knetsch and Davis 1966; Brookshire, et al. 1982; Loomis, Creel and Park 1991; Shabman and Stephenson 1996). These two groups of studies reflect use values for natural resource services and generally demonstrate hypothetical bias.

The third group of studies developed simulated market experiments to test whether CV values are comparable to the amount respondents would really pay if an actual market existed. This synthetic form of external validation involves comparing CV values to actual cash payments from a simulated market for the same commodity (Kealy, Montgomery, Dovidio 1990; Seip and Strand 1992; Bohm 1992; Duffield and Patterson 1992; Brown et al. 1996; Champ et al. 1997). For example, Duffield and Patterson (1992) compare stated and actual WTP for maintenance of instream water flows in Montana and find that CV values exceed actual payments by a factor of 4 for residents and a factor of 3 for nonresidents. Brown et al. (1996) elicited WTP for a road-removal program on the North Rim of the Grand Canyon. The results show that mean stated WTP was four to six times the mean actual WTP, with the means being statistically different.

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The last group of studies contains studies that use the referendum format to elicit WTP values for various types of goods, both private and public. In a number of these studies, the CV referenda did not reflect an actual referenda, much like the CV study that Stratus has conducted for this litigation (Cummings et al 1997; Bjornstad et al. 1997; Taylor 1998; Cummings and Taylor 1999; Taylor et al. 2001; Brown et al. 2003; Landry and List 2007; Burton et al. 2007; Carson, Groves, and List 2008). However, an actual group payment was part of the study design. Overall, these studies reveal that hypothetical bias persists, even when the referendum format is used.

A subset of the referenda studies has compared CV results from a simulated referendum for a public good to voting results from an actual referendum for the identical public good (Carson, Hannemann, and Mitchell 1986; Shabman and Stephenson 1996; Champ and Brown 1997; Vossler and Kerkvliet 2003; Vossler et al. 2003; Schläpfer Roschwitz, and Hanley 2004; Johnston 2006). Bishop (undated) contends that these studies represent the best test of hypothetical bias for the Stratus CV study and that such studies do not, generally, reflect hypothetical bias. However, a closer examination of these studies contradicts those conclusions.

Table 3.5 summarizes this set of studies. In addition to the fact that the Stratus CV survey does not reflect an actual referendum, there are three additional features of these studies that are relevant to a discussion of hypothetical bias in the Stratus CV survey. The first feature is the nature of the public good, shown in the second column of Table 3.5. The studies that do not exhibit hypothetical bias involve public services actually used by the voters. These referenda asked voters to approve bonds or other funding for the construction of sewage treatment plants, public road maintenance and improvements, public water supply provision, and river front park improvements. The one exception to this conclusion is the Shabman and Stephenson (1996) study of flood protection projects.

The commodities depicted in the two studies that clearly demonstrate hypothetical bias are open space preservation and rural landscape protection. While some voters may use open spaces and directly benefit from some rural landscape protection, other voters will not use these types of natural resource services. When the

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commodities of the hypothetical referenda studies are examined, the majority (but admittedly not all) of them are also largely nonuse commodities. Thus, the use/nonuse distinction likely explains at least part of the findings on hypothetical bias in referenda studies. Cameron and Englin (1997), Blamey, et al. (2001), Johnston, et al. (1995), and Johnston (2006) all demonstrate that first-hand experience or familiarity with the good leads to a closer correspondence between stated intentions and actual behaviors.

Table A.1: Empirical Studies on Actual Referenda

Study	Referendum	Familiarity and Salience of Proposed Project	Evidence of Hypothetical Bias?
Carson, Hanneman and Mitchell (1987)	Construction of sewage treatment plants in California in 1984	High familiarity and salience. No additional information provided in the survey.	No, only if undecided responses are recoded as no
Johnston 2006	Provision of public water supply to Village of North Scituate, RI in 2001	High familiarity and salience. No additional information provided in the survey.	No
Vossler and Kervliet 2003	Riverfront park improvements in downtown Corvallis, OR in 1998	High familiarity and salience. Community had studied the issue for 6 years. No additional information provided in the survey.	No*
Vossler, et al. (2003)	Purchase of open space near Corvallis, OR in 1995	High familiarity and salience. Most discussed item on the ballot that year. No additional information provided in the survey.	No, only if undecided responses are recoded as no
Schläpfer, Roschwitz, and Hanley (2004)	Improved protection of rural landscape near Zurich, Switzerland in 1996	Some familiarity and salience. The CV survey provided substantial information.	Yes
Shabman and Stephenson (1996)	Flood protection project in Roanoke, VA in 1989	High familiarity and salience. Flooding two years earlier caused \$200 million in property damage. The CV survey provided substantial information.	Yes

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Study	Referendum	Familiarity and Salience of Proposed Project	Evidence of Hypothetical Bias?
Champ and Brown (1997)	Use of budget surplus for road maintenance in Fort Collins, CO in 1996	High familiarity and salience. No additional information provided in the survey.	No
* However, the study was also designed to test the treatment of undecided votes. If undecided votes are re-coded as votes against, then there is a statistical difference between the actual vote and the survey results.			

The Stratus CV study has elements of both use and nonuse. Approximately 50 percent of the respondents answered “yes” when asked if they had ever visited the Illinois River or Tenkiller Lake (Tables D.14 and D.15). But less than 20 percent of the base version respondents indicate that they have visited in the last three years. Moreover, the open-ended responses from respondents who voted for the program indicate that respondents were thinking of their children, grandchildren, or others when they voted for the program (Table D.89). In light of the hypothetical bias results in referendum studies for commodities that have a nonuse component, hypothetical bias remains a fatal flaw in the Stratus CV study.

The second feature of the actual referenda studies that merits discussion is the salience and familiarity of the good to survey respondents. Certainly, this feature is related to the use values aspects identified above. However, what is an important extension of that concept is the amount of information provided to the CV survey respondents in advance of their votes in the survey. For the majority of these studies, the survey designers did not have to provide information about the issues to the respondents. In fact, Johnston (2006) believes that this lack of additional information is one of the reasons that his study does not exhibit hypothetical bias. For most of these studies, the survey respondents had access to information about the ballot issue from a variety of sources and viewpoints. The two studies that did provide substantial information to the respondents exhibit hypothetical bias. This feature is relevant to the evaluation of hypothetical bias for the Stratus CV survey. Recall that the earlier Stratus surveys from 2006 revealed minimal awareness of the algae conditions. Thus, the Stratus CV survey included a substantial amount of information in order to “educate” the respondents prior to their hypothetical votes. Providing so much information to

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respondents is a symptom of the lack of salience and a corresponding likelihood of hypothetical bias in the Stratus CV study.

The last feature of the actual referendum studies that is relevant to a discussion of hypothetical bias is the treatment of the undecided voters in the CV survey. Two of the studies that do not find hypothetical bias do so only because they treat the undecided votes as votes against. In addition, Vossler and Kerkvliet's (2003) study design includes a separate element to test for the treatment of undecided votes. They find that there is no clear evidence that undecided votes should be treated as votes against and that doing so results in statistical differences. Vossler et al. (2003) conclude that it is an open question whether undecided votes should be recoded as votes against. Wang (1997) reasons that "common sense suggests that if a respondents is answering truthfully, a DK [don't know/not sure/would not vote] response is not the same as no" (p. 220).

In an actual referendum, the undecided votes would not be counted, either because the voters did not go to the polls or because they did not make an explicit choice on their ballot. Treating the undecided votes as votes against is particularly important when predicting the WTP for the commodity. Specifically, without such an adjustment of the undecided votes, the survey results over-predict both the percentage of votes for the proposition and the WTP for the commodity at issue. This finding is pertinent to the Stratus CV survey because the Stratus study did not allow the no-vote option. Perhaps this tendency to overestimate WTP was the motivation behind the NOAA Panel's recommendation for a no-vote option. Had the Stratus study included a no-vote option, it likely would have found similar patterns.

Thus, hypothetical bias is prevalent in empirical studies. Most studies that claim to find no hypothetical bias depend on a manipulation of the undecided responses. The three studies that do not find hypothetical bias, without manipulation of the undecided responses, reflect use value goods without significant information dosing in the survey questionnaire. The weight of the evidence suggests that hypothetical bias is likely present in the Stratus CV study.

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A.1 References

- Bishop, Richard C. and Thomas A. Heberlein. "Measuring Values of Extramarket Goods: Are Indirect Measures Biased?" *American Journal of Agricultural Economics* 61(5): 926-930.
- Bishop undated. Notes on Hypothetical Bias. Bishop0001271_Notes on Hypothetical Bias.doc
- Blamey, R., J. Bennett, J.J. Louviere, and M. Morrison. 2001. "Green product choice." In: J. Bennett, R. Blamey (Eds.), *The Choice Modelling Approach to Environmental Valuation*, Edward Elgar, Northampton, MA.
- Cameron, T.A. and J. Englin. 1997. "Respondent experience and contingent valuation of environmental goods." *J. Environ. Econom. Manage.* 33(3): 296-313.
- Bjornstad, David, Ronald Cummings, and Laura Osborne. 1997. "A Learning Design for Reducing Hypothetical Bias in the Contingent Valuation Method." *Environmental and Resource Economics* 10: 207-221.
- Bohm, P. 1992. "CVM Spells Responses to Hypothetical Questions." Working paper. Stockholm: University of Stockholm, Department of Economics.
- Brookshire, D.S., M. Thayer, W.D. Schulze, and R. d'Arge. 1982. "Valuing public goods: a comparison of the survey and hedonic approaches." *Amer. Econom. Rev.* 72(1):165-177.
- Brown, Thomas C., Icek Ajzen, and Daniel Hrubes. 2003. "Further tests of entreaties to avoid hypothetical bias in referendum contingent valuation." *Journal of Environmental Economics and Management* 46:353-361.
- Brown, T.C., P.A. Champ, R.C. Bishop, and D.W. McCollum. 1996. "Which Response Format Reveals the Truth About Donations to a Public Good?" *Land Economics* 72(2):152-66.
- Burton, Anthony C., Katherine S. Carson, Susan M. Chilton, and W. George Hutchinson. 2007. "Resolving Questions About Bias in Real and Hypothetical Referenda." *Environmental Resource Economics* 38: 513-525.
- Carson, Richard, Theodore Groves, and John List. 2008. Probabilistic Influence and Supplemental Benefits A Field Test of the Two Key Assumptions Behind Using Stated Preferences. Draft: February. Bishop0000198_Carson-Groves-List 2008.pdf
- Carson, R.T., W.M. Hanemann, R.C. Mitchell. 1986. *The Use of Simulated Political Markets to Value Public Goods*. Working Paper. Economics Department, University of California, San Diego.

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- Champ, Patricia A., and Thomas C. Brown. 1997. "A Comparison of Contingent and Actual Voting Behavior." Unpublished paper, Rocky Mountain Research Station, USDA Forest Service, Fort Collins, CO.
- Cummings, Ronald G., Steven Elliott, Glenn W. Harrison, and James Murphy. 1997. "Are Hypothetical Referenda Incentive Compatible?" *The Journal of Political Economy* 105(3):609-621.
- Dickie, M., A. Fisher, and S. Gerking. 1987. "Market transactions and hypothetical demand data: a comparative study." *J. Amer. Statist. Assoc.* 82(1): 69-75.
- Duffield, J.W. and D.A. Patterson. 1992. "Field Testing Existence Values: An Instream Flow Trust Fund for Montana Rivers." Paper presented at the Allied Social Science Associations annual meeting. New Orleans, LA, January 4.
- Johnston, Robert J. 2006. "Is Hypothetical Bias Universal? Validating Contingent Valuation Responses Using a Binding Public Referendum." *Journal of Environmental Economics and Management* 52:469-481.
- Johnston, R.F., T.F. Weaver, L.A. Smith, S.K. Swallow. 1995. "Contingent valuation focus groups: insights from ethnographic interview techniques." *Agric. Resour. Econom. Rev.* 24(1): 56-69.
- Kealy, M.J., M. Montgomery, and J.F. Dovidio. 1990. "Reliability and Predictive Validity of Contingent Values: Does the Nature of the Good Matter?" *Journal of Environmental Economics and Management* 19(3):244-263.
- Knetsch, J.L. and R.K. Davis. 1966. "Comparisons of methods for recreation evaluation." In: A.V. Kneese, S.C. Smith (Eds.), *Water Research*, Resources for the Future Inc. Baltimore: John Hopkins Press. 125-142.
- Landry, Craig E., and John A. List. 2007. "Using Ex Ante Approaches to Obtain Credible Signals for Value in Contingent Markets: Evidence from the Field." *American Journal Agricultural Economics* 89(2):420-429.
- List, J.A and J.F. Shogren. 1998. "Calibration of the difference between actual and hypothetical valuations in a field experiment." *J. Econom. Behav. Organiz.* 37(2):193-206.
- Loomis, J., M. Creel, and T. Park. 1991. "Comparing benefit estimates from travel cost and contingent valuation using confidence intervals for Hicksian welfare measures." *Appl. Econom.* 23(11): 1725-1731.
- Murphy, J.J. and T.H. Stevens. 2004. "Contingent valuation, hypothetical bias, and experimental economics." *Agric. Resour. Econom. Rev.* 33(2): 182-192.
- Schläpfer, Felix, Anna Roschewitz, and Nick Hanley. 2004. "Validation of Stated Preferences for Public Goods: A Comparison." *Ecological Economics* 51:1- 16

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- Seip, K. and J. Strand. 1992. "Willingness to Pay for Environmental Goods in Norway: A Contingent Valuation Study with Real Payment." *Environmental and Resource Economics* 2(1):91–106.
- Shabman, L. and K. Stephenson. 1996. "Searching for the correct benefit estimate: empirical evidence for an alternative perspective." *Land Economics* 72(4): 433–449.
- Taylor, Laura O. 1998. "Incentive Compatible Referenda and the Valuation of Environmental Goods." *Agricultural and Resource Economics Review*, 27(2):132-39.
- Taylor, Laura O., Michael McKee, Susan K. Laury, and Ronald G. Cummings. 2001. "Induced-Value Tests of the Referendum Voting Mechanism." *Economics Letters* 71:61–65
- Vossler, Christian A. and Joe Kerkvliet. 2003. "A Criterion Validity Test of the Contingent Valuation Method: Comparing Hypothetical and Actual Voting Behavior for a Public Referendum." *Journal of Environmental Economics and Management* 45:631–649.
- Vossler, Christian A., Joe Kerkvliet, Stephen Polasky, and Olesya Gainutdinova. 2003. Externally Validating Contingent Valuation: An Open-Space Survey and Referendum in Corvallis, Oregon. *Journal of Economic Behavior & Organization* 51:261–277.
- Wang, Hua. 1997. "Treatment of 'Don't Know' Responses in Contingent Valuation Surveys: A Random Valuation Model." *Journal of Environmental Economics and Management*. 32: 219-232.

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Appendix B
Divergence Between Base and Scope Survey

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Divergence between the “base” and “scope” questionnaires in the Stratus study.

Yellow highlighting in the base survey denotes text not included in the scope survey. Red highlighting denotes numbers that are different.

The base scenario

Volume I, page 4-17 through page 4-34. Parts that are different from the “scope” scenario are highlighted:

“The ban and the other things being done will greatly reduce the amount of new phosphorus put onto land and in the river and lake in the future, but a lot of phosphorus that was spread on the land in the past will remain there. For many years, it will continue to wash into the river and lake when it rains.

“The purpose of this interview is to find out whether you think the State should or should not do something else as well. The excess phosphorus could be removed by putting alum on the land and in the water. I will tell you about what alum is and how it could be used to remove the excess phosphorus in a moment. After I tell you about the situation, I will ask you to vote on whether the state should or should not put alum on the land and in the water in order to return the river and lake to around 1960 conditions faster. Your vote will help state officials to decide whether to carry out the alum treatments.

“When alum is put into river or lake water that contains phosphorus, the alum attaches to the phosphorus to form harmless particles that fall to the bottom and blend into the dirt there. So if alum were put into the river and lake, the phosphorus there could no longer help algae to grow and there would then be a lot less algae in the water.

If alum is put on land, it attaches to phosphorus in the soil to form harmless particles. When these particles wash into rivers and lakes, the particles sink to the bottom and do not help algae to grow.

So to reduce algae in the river and lake, alum could be spread on the land and on the water.

“Here’s how the alum treatments could be done.

The Army Corps of Engineers operates the lake, and they would work with the Oklahoma Department of Environmental Quality to spread the alum.

Crews of people would be hired and trained to use trucks to put alum on the land.

Specially designed boats would spread alum on the lake.

Alum would also remove phosphorus from river water flowing into Oklahoma from Arkansas. Dispensers would be put near the border to spread alum on the water when sensors find lots of phosphorus in it.

“For more than 35 years, alum has been used successfully and safely to remove phosphorus and reduce algae in many states, such as Colorado, Texas, Missouri, South Dakota, Florida, Wisconsin, and Washington. Those states had some rivers and lakes with lots of algae like the Illinois River and Tenkiller Lake. Experiences in those states have convinced scientists that alum does not harm fish or other things living in water, and that alum treatments here in Oklahoma could safely

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return the river and lake to what they were like in around 1960. Putting alum on the land and in the water would have some undesirable effects. The alum would be a white powder on the land surface until rains carry it down into the soil. After alum is put into the river and lake, it would make the water cloudy for a few hours until it settles to the bottom. And if anyone were to drink the lake water in the first hour, it might taste bitter. Alum treatments would be needed for 5 years to remove all the excess phosphorus now on the land and in the water.

“(POINT TO ROW 1) A court-ordered ban would stop spreading of poultry litter near the river and lake in Oklahoma and Arkansas. This will occur even if alum treatments are not done.

(POINT TO ROW 2) Alum could be spread on land from trucks.

(POINT TO ROW 3) Alum could be spread on the lake from boats.

(POINT TO ROW 4) Alum could be sprayed in river water flowing into Oklahoma from Arkansas.

(POINT TO ROW 5) Alum treatments would need to be done for 5 years to remove all the excess phosphorus.

“As a result of alum treatments, the river would be back to what it was like in around 1960 (POINT TO 1960) about 10 years from now (POINT TO 10 YEARS). And the lake would be back to what it was like in around 1960 (POINT TO 1960) about 20 years from now (POINT TO 20 YEARS). Water in the river and lake would then be clear nearly all the time, and there would be little algae in the water and on the bottom. There would then be plenty of oxygen in the water. Species of fish, insects, small animals, and small plants that used to be common would slowly increase in numbers, replacing those that live in water with lots of algae. There would be fewer of some species, such as largemouth bass.

“The river and lake will go back to what they were like in around 1960 without alum, but it will take longer.

Scientists say that if spreading of poultry litter is banned, natural processes will allow the river and lake to gradually return to what they were like in around 1960, even with no alum treatments.

Rain would slowly wash the phosphorus into the river and lake for many years.

Each year, a little less phosphorus would be washed into the river and lake.

Because the river flows into the lake, the phosphorus in the river would be washed into the lake and would be kept there by the dam. The phosphorus would sink to the bottom of the lake and would slowly be covered by dirt, which would eventually seal it off, so that it could not help algae to grow.

“Without alum treatments, it will take about 50 years (POINT) for the river to get back to what it was like in around 1960 (POINT TO 1960) instead of about 10 years (POINT). That is about 40 years longer. It will take the lake about 60 years (POINT) to get back to what it was like in around 1960 (POINT TO 1960) instead of about 20 years (POINT). That is also about 40 years longer.

“If a court bans spreading of poultry litter, the industry will have to safely get rid

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of all the litter they produce from now on. The industry will have to pay for this, and the river and lake will naturally return to what they were like in around 1960. If the people of Oklahoma want this to happen **40 years sooner**, there will be an additional cost for the alum treatments. Oklahoma taxpayers will have to pay some of this cost because many chicken and turkey farms have gone out of business over the years. In addition, many other Oklahomans contributed to the excess phosphorus through sewage and their use of fertilizer. We are interviewing people in Oklahoma to ask them to vote on whether the state should or should not put alum **on the land and in the water**. Your vote today will affect whether or not alum treatments are done.

“The state does not want to start the program unless it has all the funds needed to buy the equipment, hire and train the staff, and complete the 5 years of alum **treatments**. To pay for this, Oklahoma taxpayers would pay a one-time tax added to their state income tax bill next year. The cost to your household would be \$(**BIDAMNT**). The money would go into a special trust fund that can be used only for alum treatments. This is the only payment that would be required.

“Voting for the program means (**PAUSE**) that it is worth it to you (**PAUSE**) for your household to pay the additional one-time tax of \$ (**BIDAMT**) (**PAUSE**) to return **the Illinois River, Flint Creek, Barren Fork Creek, the smaller creeks flowing into them, and** Tenkiller Lake to what they were like in around 1960 **40 years sooner**.

“(**POINT**) Natural processes will return **the river and** lake to what they were like in around 1960 **in 50 to** 60 years without alum treatments.

“**Q25.** After spreading of litter is banned, how serious did you think the effects of algae in the river would **be if no alum treatments are done**? Not serious at all, slightly serious, moderately serious, very serious, or extremely serious?

“**Q30.** **Now let's turn to the lake.** I told you it would take about 60 years for the lake to return to what it was like in around 1960 without alum treatments. When you decided how to vote, did you think that it would take about 60 years, or did you think it would take less time or more time?

“**Q31.** When you decided how to vote, how well did you think that alum treatments would work at reducing algae in **the water**? Not well at all, slightly well, moderately well, very well, or extremely well?

“**Q33.** When you decided how to vote, did you think that the extra tax money would be used for alum treatments to reduce algae in only Tenkiller **Lake and the Illinois River and creeks flowing into it**, or did you think some of this money would be used clean up other **rivers and** lakes in Oklahoma as well?

“**Q34.** When you decided how to vote, did you think that if the alum treatments are done successfully for **the Illinois River and** Tenkiller Lake, this would or would not increase the chances that other **rivers and** lakes in Oklahoma would get alum treatments later?”

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Vol. I, page 4-17 through page 4-34:

"The ban and the other things being done will greatly reduce the amount of new phosphorus put onto land and in the river and lake in the future. The excess phosphorus will quickly wash out of the river, but much of the phosphorus that's in the lake now will remain there.

"The purpose of this interview is to find out whether you think the State should or should not do something else in the lake. The excess phosphorus in the lake could be removed by putting alum in the water. I will tell you about what alum is and how it could be used to remove the excess phosphorus in the lake in a moment. After I tell you about the situation, I will ask you to vote on whether the state should or should not put alum in the lake in order to return the lake to around 1960 conditions somewhat faster. Your vote will help state officials to decide whether to carry out the alum treatments.

"When alum is put into lake water that contains phosphorus, the alum attaches to the phosphorus to form harmless particles that fall to the bottom and blend into the dirt there. So if alum were put into the lake, the phosphorus there could no longer help algae to grow and there would then be a lot less algae in the water. Alum treatments will not be needed for the river. The natural flow of water in the river will remove the excess phosphorus there. After the ban is in place, the river will naturally return to what it was like in around 1960 in 10 years. Phosphorus will remain in the lake much longer because the lake is large and the water moves through it very slowly.

"Here's how the alum treatments would be done.

The Army Corps of Engineers operates the lake, and they would work with the Oklahoma Department of Environmental Quality to spread the alum. Specially designed boats would spread alum on the lake.

"For more than 35 years, alum has been used successfully and safely to remove phosphorus and reduce algae in lakes in many states, including Colorado, Texas, Missouri, South Dakota, Florida, Wisconsin, and Washington. Those states had some lakes with lots of algae like Tenkiller Lake. Experiences in those states have convinced scientists that alum does not harm fish or other things living in lakes, and that alum treatments here in Oklahoma could safely return the lake to what it was like in around 1960.

Putting alum in the lake would have some undesirable effects. After alum is put into the lake, it would make the water cloudy for a few hours until it settles to the bottom. And if anyone were to drink the lake water in the first hour, it might taste bitter.

Alum treatments would be needed for 5 years to remove all the excess phosphorus in the lake.

"(POINT TO ROW 1) A court-ordered ban would stop spreading of poultry litter near the river and lake in Oklahoma and Arkansas. This will occur even if alum treatments are not done.

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(POINT TO ROW 2) Alum could be spread on the lake from boats.

(POINT TO ROW 3) Alum treatments would need to be done for 5 years to remove all the excess phosphorus from the lake.

"As a result of alum treatments, the lake would be back to what it was like in around 1960 **(POINT TO 1960)** about 50 years from now **(POINT TO 50 YEARS)**. Water in the lake would then be clear nearly all the time, and there would be little algae in the water and on the bottom. There would then be plenty of oxygen in the water. Species of fish, insects, small animals, and small plants that used to be common would slowly increase in numbers, replacing those that live in water with lots of algae. There would be fewer of some species, such as largemouth bass.

"Scientists say that if spreading of poultry litter is banned, natural processes will gradually return the lake to what it was like in around 1960, even with no alum treatments, **but it will take somewhat longer.**

The phosphorus remaining in the lake would sink to the bottom and would slowly be covered by dirt, which would eventually seal it off, so that it could not help algae to grow.

"Without alum treatments, it will take the lake about 60 years **(POINT)** to get back to what it was like in around 1960 **(POINT TO 1960)** instead of about 50 years **(POINT)**. That is about 10 years longer.

"If a court bans spreading of poultry litter, the industry will have to safely get rid of all the litter they produce from now on. The industry will have to pay for this. **The river will naturally return to what it was like in around 1960 in 10 years, and the lake will naturally return to what it was like in around 1960 in 60 years. If the people of Oklahoma want the lake to return to what it was like in around 1960 in 50 years rather than 60 years,** there will be an additional cost for the alum treatments. Oklahoma taxpayers will have to pay some of this cost because many chicken and turkey farms have gone out of business over the years. In addition, many other Oklahomans contributed to the excess phosphorus in the lake through sewage and their use of fertilizer.

We are interviewing people in Oklahoma to ask them to vote on whether the state should or should not put alum in the lake. Your vote today will affect whether or not alum treatments are done.

"The state does not want to start the program unless it has all the funds needed to buy the equipment, hire and train the staff, and complete the 5 years of alum treatments **to the lake.** To pay for this, Oklahoma taxpayers would pay a one-time tax added to their state income tax bill next year. The cost to your household would be \$_(BIDAMNT). The money would go into a special trust fund that can be used only for alum treatments. This is the only payment that would be required.

"Voting for the program means **(PAUSE)** that it is worth it to you **(PAUSE)** for your household to pay the additional one-time tax of \$ (BIDAMT) **(PAUSE)** to return Tenkiller Lake to what it was like in around 1960 **in 50 years rather than 60 years.**

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“(POINT) Natural processes will return the lake to what it was like in around 1960 in 60 years without alum treatments.

“Q25. After spreading of litter is banned, how serious did you think the effects of algae in the river would be? Not serious at all, slightly serious, moderately serious, very serious, or extremely serious?

“Q30. I told you it would take about 60 years for the lake to return to what it was like in around 1960 without alum treatments. When you decided how to vote, did you think that it would take about 60 years, or did you think it would take less time or more time?

“Q31. When you decided how to vote, how well did you think that alum treatments would work at reducing algae in the lake? Not well at all, slightly well, moderately well, very well, or extremely well?

“Q34. When you decided how to vote, did you think that if the alum treatments are done successfully for Tenkiller Lake, this would or would not increase the chances that other lakes in Oklahoma would get alum treatments later?”

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Appendix C
Analysis of Subgroup Respondents

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Figure C.1

		ABERS	95%Lower	95%Upper	Turnbull	95%Lower	95%Upper
	All	\$184.55	\$165.72	\$203.38	\$176.78	\$160.09	\$193.43
More/ same/ less spending on pollution	Less, Same	\$119.96	-	-	\$119.96	\$98.35	\$141.57
Visited IL River ever	No	\$163.53	-	-	\$154.21	\$125.12	\$183.31
	Yes	\$202.89	-	-	\$202.89	\$180.68	\$225.09
Visited TKL Lake ever	No	\$149.89	-	-	\$142.08	\$114.13	\$170.04
	Yes	\$216.83	-	-	\$135.00	\$126.28	\$143.72
Aware of scenic river status	No	\$175.10	\$151.32	\$198.88	\$175.10	\$155.96	\$194.24
	Yes	\$204.11	-	-	\$194.95	\$160.05	\$229.85
Heard of reason for phosphorous	No	\$186.56	\$161.66	\$211.46	\$186.56	\$166.56	\$206.56
	Yes	\$180.69	-	-	\$171.92	\$139.09	\$204.74
Effectiveness of Alum	Not, Slight, Moderate	\$100.88	-	-	\$100.88	\$81.08	\$120.68
<i>Active User of IL River</i>		\$120.54	-	-	\$120.54	\$90.67	\$150.41
<i>Active User of TKL Lake</i>		\$120.65	-	-			
<i>Passive User of TKL Lake</i>		\$85.09	-	-	\$85.09	\$62.59	\$107.59
Effectiveness of Alum	Very, Extreme	\$244.77	\$220.08	\$269.47			
<i>Active User of IL River</i>		\$262.99	-	-	\$257.53	\$221.18	\$293.88
<i>Passive User of IL River</i>		\$223.47	-	-	\$209.28	\$168.69	\$249.86
Tax goes to treat other lakes and rivers	No	\$198.66	-	-	\$198.66	\$173.00	\$224.32
	Yes	\$179.43	\$159.01	\$199.85	\$145.83	\$173.13	\$200.44
Plan to leave OK in next year	No	\$178.93	\$157.98	\$199.89	\$170.49	\$147.53	\$193.44
Paid taxes in 2007	Yes	\$185.61	\$167.14	\$204.08	\$180.87	\$157.98	\$199.89
Difficulty paying tax	Extreme, Very	\$101.42	-	-	\$94.79	\$70.74	\$118.84
	Slight, Not	\$244.77	\$220.08	\$269.47	\$235.29	\$207.89	\$262.68
Quartiles of HH income before taxes	y>\$150,000	\$189.02	-	-	\$172.97	\$104.26	\$241.67
	\$50,000<y<\$150,000				\$176.72	\$148.34	\$204.10
	\$22,750<y<\$50,000	\$184.28	-	-	\$176.80	\$133.73	\$219.87
	0<y<\$22,750	\$187.67	-	-			

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Table C.1: Comparison of WTP for Active v. Passive Users of IL River**Q14: Have you ever visited the IL River?**

	No (Passive Users)			Yes (Active Users)		
	WTP	Lower 95%	Upper 95%	WTP	Lower 95%	Upper 95%
ABERS	\$163.53			\$202.89		
TRNBL	\$154.21	\$125.12	\$183.31	\$202.89	\$180.68	\$225.09
	Pr(Yes Bid)	Lower 95%	Upper 95%	Pr(Yes Bid)	Lower 95%	Upper 95%
\$10	0.75	0.75	0.75	0.85	0.85	0.85
\$45	0.65	0.65	0.65	0.76	0.76	0.76
\$80	0.57	0.57	0.57	0.64	0.64	0.64
\$125	0.62	0.62	0.62	0.61	0.61	0.61
\$205	0.39	0.39	0.39	0.48	0.48	0.48
\$405	0.27	0.27	0.27	0.40	0.40	0.40

Table C.2: Comparison of WTP for Differences in Perceived Effectiveness**(Q31: How effective do you think the alum treatment will be?)**

	Not, Slightly, Moderately			Very, Extremely		
	WTP	Lower 95%	Upper 95%	WTP	Lower 95%	Upper 95%
ABERS	100.88			244.77	220.08	269.47
TRNBL	100.88	81.08	120.68	235.29	207.89	262.68
	Pr(Yes Bid)	Lower 95%	Upper 95%	Pr(Yes Bid)	Lower 95%	Upper 95%
\$ 10	0.65	0.52	0.52	0.65	0.52	0.52
\$ 45	0.49	0.34	0.34	0.49	0.34	0.34
\$ 80	0.44	0.59	0.59	0.44	0.59	0.59
\$ 125	0.36	0.12	0.12	0.36	0.12	0.12
\$ 205	0.24	0.00	0.00	0.24	0.00	0.00
\$ 405	0.13	0.00	0.00	0.13	0.00	0.00

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Table C.3: Comparison of WTP for Different Views Regarding State Spending**Q7e: Should the state spend less, same, or more on pollution?**

	Less, Same			More		
	WTP	Lower 95%	Upper 95%	WTP	Lower 95%	Upper 95%
ABERS	119.96					
TRNBL	119.96	98.35	141.57			
	Pr(Yes)	Lower 95%	Upper 95%	Pr(Yes)	Lower 95%	Upper 95%
\$ 10	0.67	0.67	0.67	0.67	0.67	0.67
\$ 45	0.60	0.60	0.60	0.58	0.58	0.58
\$ 80	0.57	0.57	0.57	0.56	0.56	0.56
\$ 125	0.51	0.51	0.51	0.52	0.52	0.52
\$ 205	0.35	0.35	0.35	0.37	0.37	0.37
\$ 405	0.11	0.11	0.11	0.10	0.10	0.10

Table C.4: WTP and Confidence Intervals for Income Quintiles

	ABERS	Turnbull	Lower 95%	Upper 95%
\$64,000<y<\$600,001	\$158.78	\$139.33	\$67.47	\$211.18
\$43,000<y<\$64,000	\$192.85	\$157.10	\$141.15	\$173.04
\$27,000<y<\$43,000	\$188.38	\$188.38	\$151.29	\$225.47
\$15,000<y<\$27,000	\$198.91	\$195.16	\$155.28	\$235.04
\$0<y<\$15,000	\$183.72	\$160.09	\$125.70	\$194.48

Table C.5: WTP and Confidence Intervals for Income Sextiles

	ABERS	Turnbull	Lower 95%	Upper 95%
\$70,000<y<\$60,000	\$145.93	\$121.11	\$50.84	\$191.38
\$50,000<y<\$70,000	\$216.26	\$72.07	\$65.01	\$79.13
\$33,000<y<\$50,000	\$178.89	\$166.00	\$122.54	\$209.47
\$23,000<y<\$33,000	\$186.87	\$186.87	\$151.83	\$221.91
\$13,000<y<\$23,000	\$172.08	\$161.20	\$100.95	\$221.44
\$0<y<\$13,000	\$202.14	\$192.04	\$135.39	\$248.69

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Appendix D
WTP Estimates with Recoded Data

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Table D.1: ABERS WTP Estimates for Original and Recoded Data

Dataset	WTP Estimate	% Decline
Stratus Original Estimate	\$184.55	0.0%
Recode: Alum Without Ban	\$153.39	-16.9%
Recode: Certainty	\$131.62	-28.7%
Recode: Faster - River	\$144.62	-21.6%
Recode: Faster - Lake	\$141.92	-23.1%
Recode: Pay Other River/Lake	\$103.15	-44.1%
Recode: Income Tax	\$116.47	-36.9%
Combined Recodes	\$37.98	-79.4%

Table D.2: ABERS WTP Estimates for Passive and Active Users of the Illinois River

Dataset	Passive IL River		Active IL River	
	ABERS WTP	% Decline	ABERS WTP	% Decline
Stratus Original	\$163.53	0.0%	\$202.89	0.0%
Recode: Alum Without Ban	\$129.42	-20.9%	\$174.54	-14.0%
Recode: Certainty	\$117.20	-28.3%	\$144.16	-28.9%
Recode: Faster - River	\$115.00	-29.7%	\$115.56	-43.0%
Recode: Faster - Lake	\$114.33	-30.1%	\$165.71	-18.3%
Recode: Pay Other River/Lake	\$89.13	-45.5%	115.56	-43.0%
Recode: Income Tax	88.68	-45.8%	\$139.52	-31.2%
Combined Recodes	\$29.50	-82.0%	18.8	-90.7%

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**Table D.3: ABERS WTP Estimates for
Passive and Active Users of Tenkiller Lake**

Dataset	Passive Lake		Active Lake	
	ABERS WTP	% Decline	ABERS WTP	% Decline
Stratus Original	\$149.89	0.0%	\$216.83	0.0%
Recode: Alum Without Ban	\$114.89	-23.4%	\$191.34	-11.8%
Recode: Certainty	\$108.75	-27.4%	\$154.36	-28.8%
Recode: Faster - River	\$109.35	-27.0%	\$174.35	-19.6%
Recode: Faster - Lake	115.29	-23.1%	-	-
Recode: Pay Other River/Lake	\$87.39	-41.7%	\$119.30	-45.0%
Recode: Income Tax	\$95.20	-36.5%	\$137.40	-36.6%
Combined Recodes	\$32.55	-78.3%	\$42.65	-80.3%

**Table D.4: ABERS WTP Estimates by respondents' belief in alum treatment
effectiveness: Not, Slightly, Moderate versus Very or Extremely**

Dataset	Not/Slightly/ Moderate	% Decline	Very/ Extremely	% Decline
Stratus Original	\$100.88	0.0%	\$244.77	0.0%
Recode: Alum Without Ban	\$82.10	-18.6%	\$204.38	-16.5%
Recode: Certainty	\$46.92	-53.5%	\$189.34	-22.6%
Recode: Faster - River	\$71.06	-29.6%	\$196.69	-19.6%
Recode: Faster - Lake	\$67.86	-32.7%	\$194.47	-20.5%
Recode: Pay Other River/Lake	\$48.50	-51.9%	\$142.43	-41.8%
Recode: Income Tax	\$69.39	-31.2%	\$149.34	-39.0%
Combined Recodes	\$10.74	-89.4%	\$56.15	-77.1%

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Table D.5: ABERS WTP Estimates by Respondents' Belief that state should spend less, or the same on pollution (Q7e)

Dataset	WTP Estimate	% Decline
Stratus Original	\$119.96	0.0%
Recode: Alum Without Ban	\$106.64	-11.1%
Recode: Certainty	\$86.84	-27.6%
Recode: Faster - River	\$94.20	-21.5%
Recode: Faster - Lake	\$90.79	-24.3%
Recode: Pay Other River/Lake	\$65.82	-45.1%
Recode: Income Tax	\$62.09	-48.2%
Combined Recodes	\$28.58	-76.2%

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Appendix E
Income Elasticities by Quartile, Quintile, and Sextile for
Recoded Data

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Table E.1: Income Elasticities by Income Quartile

	Quartile	Max Income	Income Elasticities
Stratus	1	\$600,001	0.20
	2	\$60,000	0.18
	3	\$33,000	-0.40
	4	\$18,000	
All revisions	1	\$600,001	
	2	\$60,000	
	3	\$33,000	0.11
	4	\$18,000	-0.09
Ban	1	\$600,001	0.06
	2	\$60,000	-0.14
	3	\$33,000	-0.38
	4	\$18,000	0.09
Certainty	1	\$600,001	0.25
	2	\$60,000	0.21
	3	\$33,000	0.22
	4	\$18,000	0.12
Faster - River	1	\$600,001	0.57
	2	\$60,000	0.96
	3	\$33,000	-0.84
	4	\$18,000	0.02
Faster - Lake	1	\$600,001	0.16
	2	\$60,000	1.12
	3	\$33,000	-1.24
	4	\$18,000	0.52
Other River/Lake	1	\$600,001	0.37
	2	\$60,000	-1.25
	3	\$33,000	-0.02
	4	\$18,000	0.08
Income Tax	1	\$600,001	0.20
	2	\$60,000	-0.59
	3	\$33,000	-0.71
	4	\$18,000	0.19

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Table E.2: Income Elasticities by Income Quintile

	Quartile	Max Income	Income
Stratus	1	\$600,001	0.200
Stratus	2	\$60,000	0.177
Stratus	3	\$33,000	-0.397
Stratus	4	\$18,000	
All revisions	1	\$600,001	
All revisions	2	\$60,000	
All revisions	3	\$33,000	0.113
All revisions	4	\$18,000	-0.091
Ban	1	\$600,001	0.064
Ban	2	\$60,000	-0.137
Ban	3	\$33,000	-0.384
Ban	4	\$18,000	0.088
Certainty	1	\$600,001	0.254
Certainty	2	\$60,000	0.214
Certainty	3	\$33,000	0.221
Certainty	4	\$18,000	0.122
Faster - River	1	\$600,001	0.572
Faster - River	2	\$60,000	0.960
Faster - River	3	\$33,000	-0.836
Faster - River	4	\$18,000	0.024
Faster - Lake	1	\$600,001	0.159
Faster - Lake	2	\$60,000	1.122
Faster - Lake	3	\$33,000	-1.236
Faster - Lake	4	\$18,000	0.517
Other River/Lake	1	\$600,001	0.375
Other River/Lake	2	\$60,000	-1.247
Other River/Lake	3	\$33,000	-0.022
Other River/Lake	4	\$18,000	0.080
Income Tax	1	\$600,001	0.196
Income Tax	2	\$60,000	-0.588
Income Tax	3	\$33,000	-0.711
Income Tax	4	\$18,000	0.190

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Table E.3: Income Elasticities by Income Sextile

	Sextile	Max Income	Income
Stratus	1	\$600,001	-0.09
Stratus	2	\$70,000	
Stratus	3	\$50,000	1.51
Stratus	4	\$33,000	-0.59
Stratus	5	\$23,000	-0.70
Stratus	6	\$13,000	0.16
All revisions		-\$25	
All revisions		\$0	
Ban	1	\$600,001	-0.21
Ban	2	\$70,000	0.68
Ban	3	\$50,000	1.59
Ban	4	\$33,000	-0.51
Ban	5	\$23,000	-0.92
Ban	6	\$13,000	0.06
Certainty	1	\$600,001	0.00
Certainty	2	\$70,000	1.06
Certainty	3	\$50,000	4.42
Certainty	4	\$33,000	0.55
Certainty	5	\$23,000	-3.78
Certainty	6	\$13,000	-0.05
Faster – River	1	\$600,001	0.05
Faster – River	2	\$70,000	-0.38
Faster – River	3	\$50,000	4.65
Faster – River	4	\$33,000	-1.05
Faster – River	5	\$23,000	-2.82
Faster – River	6	\$13,000	-0.27
Faster – Lake	1	\$600,001	-0.07
Faster – Lake	2	\$70,000	1.34
Faster – Lake	3	\$50,000	3.67
Faster – Lake	4	\$33,000	-1.70
Faster - Lake	5	\$23,000	-2.14
Faster - Lake	6	\$13,000	-0.37
Other River/Lake	1	\$600,001	-2.23
Other River/Lake	2	\$70,000	0.00
Other River/Lake	3	\$50,000	7.26
Other River/Lake	4	\$33,000	-0.57
Other River/Lake	5	\$23,000	-2.41
Other River/Lake	6	\$13,000	-0.06
Income Tax	1	\$600,001	-5.94
Income Tax	2	\$70,000	0.00
Income Tax	3	\$50,000	3.02
Income Tax	4	\$33,000	-0.69
Income Tax	5	\$23,000	0.12
Income Tax	6	\$13,000	-0.99

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Appendix F
Curriculum Vitae for
William H. Desvousges, Ph.D. and Gordon C. Rausser, Ph.D.

William H. Desvousges, Ph.D.
President

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Employment Chronology

2005 to date	President W.H. Desvousges & Associates, Inc.
1994 to 2005	President Triangle Economic Research Durham, NC
1996 to 1999	Research Professor Duke University Durham, NC
1989 to 1994	Program Director/Senior Program Director Center for Economics Research Research Triangle Institute Research Triangle Park, NC
1980 to 1989	Senior Economist Center for Economics Research Research Triangle Institute Research Triangle Park, NC
1975 to 1980	Assistant/Associate Professor Department of Economics University of Missouri at Rolla Rolla, MO
1986	Visiting Lecturer Meredith College Raleigh, NC
1984 to 1985	Visiting Lecturer University of North Carolina at Chapel Hill Chapel Hill, NC
1980 to 1984	Visiting Lecturer North Carolina State University Raleigh, NC

Education

Ph.D., 1977, Economics, Florida State University, Tallahassee, Florida

M.S., 1974, Economics, Florida State University, Tallahassee, Florida

B.A., 1972, Economics, Stetson University, Deland, Florida

Key Projects

- “Evaluation of the Use of Survey Methods by Appraisers to Value a Commercial Property” (ChevronTexaco)
- “Evaluation of the Use of Contingent Valuation Surveys to Measure Diminished Property Values in Mississippi” (confidential client)
- “Evaluation of Market and Survey-Based Methods for Measuring Damages from Underground Storage Tanks (USTs) to Both Residential and Commercial Properties” (confidential client)
- “The Role of Individual Factors in Using Market and Survey-Based Methods for Measuring Potential Damages to Classes of Residential Properties in Colorado Springs, Colorado” (Davis Graham Stubbs)
- “The Role of Individual Factors in Using Market and Survey-Based Methods for Measuring Both Residential and Commercial Properties in Oklahoma” (confidential client)
- “The Reliability of Survey and Market-Based Methods for Measuring Damages from Increased Eutrophication in Lakes” (confidential clients)
- “Comments on the Benefit Estimates of EPA’s Proposed Phase II 316(b) Rule” (The Utility Water Act Group)
- “Benefit-Cost Analysis of Various Regulatory Alternatives for 316(b) Compliance in Connecticut” (confidential client)
- “Benefit-Cost Analysis of 316(b) Regulatory Alternatives in California” (confidential client)
- “Groundwater Damages at the South Valley Superfund Site in New Mexico” (confidential client)
- “Creel/Angler Survey on the Lower Passaic River” (Chemical Land Holdings)
- “Human Use Compensatory Restoration Strategy for Onondaga Lake” (Honeywell International)

- “Review of New Jersey’s Groundwater Damage Assessment Formula” (New Jersey Site Remediation Industry Network)
- “Environmental Costs for Particulate Matter and Mercury: An Assessment of the Recent Literature” (Xcel Energy)
- NRDA for a major waterway in the Northeast (confidential client)
- “Alternative Santa Clara River HEA” (confidential client)
- “Saginaw Bay and River Natural Resource Damage Assessment” (General Motors)
- “Evaluating the Reliability of Contingent Valuation (U.S. Environmental Protection Agency)
- “Measuring Environmental Costs for Resource Planning” (Northern States Power Company)
- “Natural Resource Damage Assessment for Lavaca Bay, Texas” (Alcoa)
- “Natural Resource Damage Assessment for the Clark Fork Basin in Montana” (ARCO)
- “Using Conjoint Analysis to Value Health” (Health Canada et al.)
- “Wisconsin Energy Research Project” (consortium of Wisconsin utilities)
- “Estimating the Market Potential For ‘Green’ Products” (Niagara Mohawk)
- “Fox River Natural Resource Damage Assessment” (Fox River Group)
- “Kalamazoo River Natural Resource Damage Assessment” (Kalamazoo River Study Group)
- “St. Lawrence River-Massena Natural Resource Damage Assessment” (Reynolds, Alcoa, General Motors)
- “Wisconsin Externalities Costing: Principles & Practices” (Task Force on Externality Costing, Wisconsin utilities)
- “Measuring Benefits of the Effluent Guidelines: An Evaluation of the Benefits Transfer Technique” (Office of Science and Technology, U.S. Environmental Protection Agency)
- “Information, Risk Perception, and Mitigation: Behavioral Responses to Environmental Risk” (National Science Foundation)
- “Natural Resource Damage Assessments for the Martinez, California; Gasconade River, Missouri; and Arthur Kill, New Jersey Oil Spills” (various clients)

- “Communicating Risk Effectively” (Office of Policy Planning and Evaluation, U.S. Environmental Protection Agency)
- “Valuing Reductions in Hazardous Waste Risks” (Office of Policy Analysis, U.S. Environmental Protection Agency)
- “Evaluating Risks of a High-Level Nuclear Waste Repository” (State of Nevada)
- “A Comparison of Benefit Estimation Approaches” (Office of Policy Analysis, U.S. Environmental Protection Agency)

Expert Reports

- Affidavit of William H. Desvousges, Ph.D. in the *Matter of Jeff Alban, et al. v. ExxonMobil Corporation, et al.* Submitted to the In Circuit Court for Baltimore County. Case No.:03-C-06-010932
- Affidavit of William H. Desvousges, Ph.D. in Support of Defendants’ Opposition to Motion for Class Certification in the *Matter of Murray Gintis, Victoria Gintis and Claudia Martin on behalf of themselves and all others similarly situated v. Bouchard Transportation Company, Inc., Tug Evening Tide Corporation and B. NO. 120 Corporation.* Submitted to the United States District Court for the District of Massachusetts. Civil Action No. 06-10747-JLT. July 29.
- Expert Report of William H. Desvousges, Ph.D. Submitted in Support of Defendants’ Opposition to Plaintiffs’ Motion for Partial Summary Judgment in the *Matter of Murray Gintis, Victoria Gintis and Claudia Martin on behalf of themselves and all others similarly situated v. Bouchard Transportation Company, Inc., Tug Evening Tide Corporation and B. NO. 120 Corporation.* July 10.
- Rebuttal Expert Report of William H. Desvousges, Ph.D. in the *Matter of USA v. Water Supply & Storage.* October 24, 2007.
- Expert Report of William H. Desvousges, Ph.D. in the *Matter of USA v. Water Supply & Storage.* September 27, 2007.
- “Expert Reports in the *Matter of Official Committee of Unsecured Creditors v. ASARCO LLC (In re ASARCO LLC), Case No. 05-21207.*”
 - Estimate of Environmental Liabilities. California Gulch Superfund Site. Leadville, Colorado. Prepared by ENVIRON International Corporation, Chicago, Illinois and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. May 4, 2007.
 - Estimate of Environmental Liabilities. Bunker Hill Superfund Facility/Coeur d’Alene Basin. Idaho/Washington. Prepared by

ENVIRON International Corporation Chicago, Illinois and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. June 15, 2007.

- Estimate of Environmental Liabilities. Tacoma Smelter Site. Tacoma, Washington. Prepared by ENVIRON International Corporation Chicago, Illinois and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. June 15, 2007.
- Estimate of Environmental Liabilities. Everett Smelter Site. Everett, Washington. Prepared by ENVIRON International Corporation Chicago, Illinois and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. June 15, 2007.
- Rebuttal Expert Report. California Gulch Superfund Site. Leadville, Colorado. Prepared for Milbank, Tweed, Hadley & McCloy LLP. On behalf of ASARCO Incorporated. Prepared by ENVIRON International Corporation Chicago, Illinois and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. June 22, 2007.
- Estimate of Environmental Liabilities. Nueces Bay/Corpus Christi Bay. Corpus Christi, Nueces County, Texas. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. Big River Mine Tailings and Federal Mine Tailings Sites. St. Francois County, Missouri. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. Catherine Mine Site/Madison County Mines Site. Madison County, Missouri. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. Glover Lead Facility. Glover, Missouri. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. Sweetwater Mine Site. Reynolds County, Missouri. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. West Fork Mine Site. Reynolds County, Missouri. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc.

Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.

- Estimate of Environmental Liabilities. Tar Creek Site. Ottawa County, Oklahoma. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. Cherokee County Superfund Site. Cherokee County, Kansas. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. Newton County Mine Tailings Site. Newton County, Missouri. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Estimate of Environmental Liabilities. Jasper County Superfund Site. Jasper County, Missouri. Prepared by ENVIRON International Corporation St. Peters, Missouri and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. On behalf of ASARCO Incorporated. July 27, 2007.
- Rebuttal Expert Report. Bunker Hill Superfund Facility/Coeur d'Alene Basin. Idaho/Washington. Prepared for Milbank, Tweed, Hadley & McCloy LLP. On behalf of ASARCO Incorporated. Prepared by W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. August 10, 2007.
- Rebuttal Expert Report. Tacoma Smelter Site. Tacoma, Washington. Prepared for Milbank, Tweed, Hadley & McCloy LLP. On behalf of ASARCO Incorporated. Prepared by ENVIRON International Corporation Chicago, Illinois and W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. August 14, 2007.
- Rebuttal Expert Report. Nueces Bay/Corpus Christi Bay Corpus Christi, Nueces County, Texas. Prepared for Milbank, Tweed, Hadley & McCloy LLP. On behalf of ASARCO Incorporated. Prepared by W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. September 17, 2007.
- Rebuttal Expert Report. Tri-State Sites. Prepared for Milbank, Tweed, Hadley & McCloy LLP. On behalf of ASARCO Incorporated. Prepared by W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. September 17, 2007.
- Rebuttal Expert Report. East Helena Superfund Site, East Helena, Montana. Prepared for Milbank, Tweed, Hadley & McCloy LLP. On

behalf of ASARCO Incorporated. Prepared by W.H. Desvousges & Associates, Inc. Raleigh, North Carolina. November 2, 2007.

- "Expert Report in the Matter of *New Jersey Department of Environmental Protection and Acting Administrator, New Jersey Spill Compensation Fund v. Higgins Disposal, et al.*" March 16, 2006.
- "Expert Report in the Matter of *New Jersey Department of Environmental Protection and Acting Administrator, New Jersey Spill Compensation Fund v. Exxon Mobil Corporation, et al.*" March 3, 2006.
- "Expert Affidavit of William H. Desvousges In Support Of Defendant's Opposition To Plaintiffs' Motion For Partial Summary Judgment in the Matter of *New Jersey Department of Environmental Protection and Administrator New Jersey Spill Compensation fund v. Exxon Mobil Corporation.*" February 17, 2006.
- "Expert Report in the Matter of *Fisher, et al. v. Ciba Corporation.*" February 15, 2006.
- "Expert Report in the Matter of *Perrine, et al. v. E.I. DuPont De Nemours and Company, et al.*" February 3, 2006.
- "Expert Report in the Matter of *Estate of David Hill, et al. v. Koppers Industries, Inc., et al.*" January 26, 2006.
- "Second Expert Report in the Matter of *Allgood, et al. v. General Motors Corporation.*" September 29, 2005.
- "Expert Report in the Matter of *Jackson, et al. v. Johnson Electric Automotive, Inc., et al.*" August 15, 2005.
- "Expert Report in the Matter of *Beck, et al. v. Koppers Industries, Inc., et al.*" August 1, 2005.
- "Declaration of William H. Desvousges, Ph.D. Pursuant to 28 U.S.C. § 1746." April 15, 2005.
- "Supplemental Report in the Matter of *Palmisano, et al. v. Olin Corporation.*" February 7, 2005.
- "Expert Report in the Matter of *Allgood, et al. v. General Motors Corporation.*" January 17, 2005.
- "Expert Report in the Matter of *LaBauve, et al. v. Olin Corporation.*" December 10, 2004.
- "Expert Report in the Matter of *Cole, et al. v. ASARCO, et al.*" August 23, 2004.
- "Expert Report in the Matter of *Daniels, et al. v. Olin Corporation.*" August 16, 2004.

- “Expert Report in the Matter of *Kellum, et al. v. Kuhlman Corporation, et al.*” July 2003.
- “Expert Report in the Matter of *Susann Stalcup, et al. v. Schlage Lock Company, et al.*” April 1, 2003.
- “Expert Report in the Matter of *Muise/Tzannetakis, et al. v. GPU Energy.*” December 2, 2002.
- “Expert Report in the Matter of *State of New Mexico v. General Electric Company, et al.*” February 1, 2002.
- “Expert Report in the Matter of *Major Andrews, et al. v. Kerr-McGee Corporation, Inc., et al.*” June 29, 2001.
- “Expert Report: *Volume I: Critique of the State of Montana’s Contingent Valuation Study.*” 1995. Submitted to United States District Court, District of Montana, Helena Division in the Matter of *State of Montana v. Atlantic Richfield Company*. Case No. CV-83-317-HLN-PGH.
- “Expert Report: *Volume II: Critique of the State of Montana’s Recreation Study.*” 1995. Submitted to United States District Court, District of Montana, Helena Division in the Matter of *State of Montana v. Atlantic Richfield Company*. Case No. CV-83-317-HLN-PGH.
- “Expert Report of William H. Desvousges and Steven M. Waters: *Volume III: Report on Potential Economic Losses Associated with Recreation Services in the Upper Clark Fork River Basin.*” 1995. Submitted to United States District Court, District of Montana, Helena Division in the Matter of *State of Montana v. Atlantic Richfield Company*. Case No. CV-83-317-HLN-PGH.
- “Expert Report: *Volume IV: Critique of the State of Montana’s Groundwater Valuation.*” 1995. Submitted to United States District Court, District of Montana, Helena Division in the Matter of *State of Montana v. Atlantic Richfield Company*. Case No. CV-83-317-HLN-PGH.
- “Expert Report: *Volume V: Report on Potential Economic Losses Associated with Groundwater.*” 1995. Submitted to United States District Court, District of Montana, Helena Division in the Matter of *State of Montana v. Atlantic Richfield Company*. Case No. CV-83-317-HLN-PGH.
- “Expert Report of William H. Desvousges and Steven M. Waters: *Volume VI: Additional Economic Critique of the State of Montana’s Damage Estimates.*” 1995. Submitted to United States District Court, District of Montana, Helena Division in the Matter of *State of Montana v. Atlantic Richfield Company*. Case No. CV-83-317-HLN-PGH.

Testimony

Provided expert witness testimony in the *Matter of USA v. Water Supply & Storage*. November 28, 2007.

Provided expert witness testimony in the *Matter of Official Committee of Unsecured Creditors v. ASARCO LLC (In re ASARCO LLC)*, Case No. 05-21207. Bunker Hill Superfund Facility/Coeur d'Alene Basin. Idaho/Washington. Settlement Hearing. October 9-12, 2007.

Provided expert witness testimony in the *Matter of Official Committee of Unsecured Creditors v. ASARCO LLC (In re ASARCO LLC)*, Case No. 05-21207. Bunker Hill Superfund Facility/Coeur d'Alene Basin. Idaho/Washington. Deposition. September 26, 2007.

Provided expert witness testimony in the *Matter of Official Committee of Unsecured Creditors v. ASARCO LLC (In re ASARCO LLC)*, Case No. 05-21207. California Gulch Superfund Site Settlement Hearing. July 27, 2007.

Provided expert witness testimony in the *Matter of Official Committee of Unsecured Creditors v. ASARCO LLC (In re ASARCO LLC)*, Case No. 05-21207. California Gulch Superfund Site Deposition. July 24, 2007.

Provided expert witness testimony in the *Matter of New Jersey Department of Environmental Protection and Acting Administrator, New Jersey Spill Compensation Fund v. Exxon Mobil Corporation, et al.* March 28, 2006.

Provided expert witness testimony in the *Matter of Fisher, et al. v. Ciba Corporation*. March 2, 2006.

Provided expert witness testimony in the *Matter of Allgood, et al. v. General Motors Corporation*. February 15, 2006.

Provided expert witness testimony in the *Matter of Palmisano, et al. v. Olin Corporation*. February 23, 2005.

Provided expert witness testimony in the *Matter of LaBauve, et al. v. Olin Corporation*. Civil No. 03-567 in the U.S. District Court, Southern District of Alabama. February 14, 2005.

Provided expert witness testimony in the *Matter of Betty Jean Cole, et al. v. ASARCO Incorporated, et al.* Case No. 03-CV-327(H) M in the U.S. District Court, Northern District of Oklahoma. October 8, 2004.

Provided expert witness testimony in the *Matter of Daniels, et al. and Palmisano, et al. v. Olin Corporation, et al.* Case No. C 03-01211 RMW in the U.S. District Court, Northern District of California, San Jose Division. September 21 and 22, 2004 and February 23, 2005.

Provided expert witness testimony and participated in Daubert hearing in the *Matter of State of New Mexico v. General Electric Company, et al.* Case No.

CIV 99-1254, Case No. CIV 99-1118. Consolidated by Order dated June 14, 2000. January 2004.

Provided testimony to the Public Service Commission of Wisconsin in the Matter of "Application of Wisconsin Electric Power Company; Wisconsin Energy Corporation; and W.E. Power, LLC for a Certificate of Public Convenience and Necessity for Construction of Three Large Electric Generation Facilities, the Elm Road Generating Station, and Associated High Voltage Transmission Interconnection Facilities to be Located in Milwaukee and Racine Counties. Docket No. 05-CE-130. September 8, 2003.

Provided expert witness testimony in the Matter of *Kellum, et al. v. Kuhlman Corporation, et al.* Civil Action No. 2001-0313 through 2001-324 in the Circuit Court of Copiah County, Mississippi. August 19 and August 20, 2003.

Provided expert witness testimony in the Matter of *Susann Stalcup, Craig Lewis and Sharon Lewis v. Schlage Lock Company, Ingersoll-Rand Company and Eagle-Picher Industries, Inc.* Case No. 02-RB01188(OES). June 12, 2003.

Provided expert witness testimony in the Matter of *Mary Louise Fairey, et al. v. the Exxon Corporation, Standard Oil Company, et al.* Case No. 94-CP-38-118. March 13 and June 3, 2003.

Provided expert witness testimony in the Matter of *Muise/Tzannetakis, et al. v. GPU Energy.* January 22, 2003.

Provided expert witness testimony in the Matter of *Andrews, et al. v. Kerr-McGee Corporation, et al.* Civil Action No. 1:00-CV-00158-B-A in the U.S. District Court, Northern District of Mississippi, Eastern Division. October 16, 2001.

Provided expert witness testimony in the Matter of *State of New Mexico v. General Electric Company, et al.* Case No. CIV 99-1254, Case No. CIV 99-1118. Consolidated by Order dated June 14, 2000.

Provided expert witness testimony in the Matter of *State of Montana v. Atlantic Richfield Company* in the U.S. District Court, District of Montana, Helena Division. Case No. CV-83-317-HLN-PGH. July 13, 1995. Rebuttal Testimony provided February 1, 1996.

Provided testimony on the Matter of "The Role of Contingent Valuation in Natural Resource Damage Assessment" before the U.S. House of Representatives Subcommittee on Commerce, Trade, and Hazardous Materials. June 20, 1995.

Provided testimony before the Public Utilities Commission of the State of Minnesota in the Matter of "The Quantification of Environmental Costs." Docket No. E-999/CI-93-583. Testimony in November 1994. Rebuttal in March 1995, and Sur-rebuttal in April 1995.

Testified before the National Oceanic and Atmospheric Administration (NOAA) Contingent Valuation Panel in the Matter of "Using CV to Measure Nonuse Damages: An Assessment of Validity and Reliability." August 12, 1992.

Provided testimony to Wisconsin Public Service Commission in the Matter of "Accounting for Environmental Externalities in Electric Utility Planning." November 26, 1991.

Areas of Specialization

Property Valuation

Prepared expert report that critiqued reports provided by the plaintiff's economic experts in a lawsuit alleging groundwater contamination at a Superfund site in the western U.S. Created a sophisticated hedonic property value model demonstrating that the Superfund site had no effect on residential property values.

In several states, directed projects evaluating the use of surveys to measure diminished property values, commercial and residential property values, potential damages to residential and commercial properties, and potential damages from various contaminants.

Critiqued the contingent valuation survey of a plaintiff's expert in a series of lawsuits alleging property damages caused by a wood-treating facility in Mississippi. Demonstrated that the survey is unreliable for use in litigation.

Natural Resource Damage Assessment

Assisted in NRD assessment for a process-water release (confidential client).

Prepared assessment of proposed changes to DOI NRDA rules.

Developed comprehensive assessment plans for complex assessments.

Performed preliminary assessments for both oil-spill and hazardous-waste sites.

Designed state-of-the-art studies to measure potential losses for recreation and groundwater services. Studies included data-collection protocols and implementation.

Performed critical analyses of studies that used contingent valuation to measure nonuse values.

Designed and directed studies to measure potential recreation losses and to evaluate potential restoration gains.

Critiqued the transfer study used by the plaintiff's expert in a Louisiana lawsuit seeking restoration funds to convert floatant freshwater marsh habitat to uplands. Provided an alternative estimate of the value of the wetlands.

Benefit/Cost Analysis

Prepared comments on economic issues in EPA's proposed 316(b) regulations for The Utility Water Act Group.

Directed a benefit analysis of technology-based effluent guidelines for municipal and industrial dischargers.

Directing projects to measure benefits of 316(b) regulatory alternatives for several utility clients

Served on peer review committee associated with benefits transfer data needs for Environment Canada.

Served as peer reviewer on benefits transfer for Ontario Ministry of the Environment.

Directed a feasibility study of using benefit-cost techniques to assist in the planning of estuaries cleanup. The study used case studies of two estuaries: the Albemarle and Pamlico Sounds.

Prepared a handbook on benefit-cost assessment for water programs that included chapters on measuring benefits and costs, selecting a discount rate, and assembling a benefit-cost assessment.

Compared alternative approaches for estimating the recreation and related benefits of the Monongahela River in Pennsylvania. Developed a survey questionnaire to measure recreation, user, option, and existence benefits for different levels of water quality. The survey design enabled a comparison of bidding games, direct-question, and contingent-ranking techniques for measuring benefits. Used clustered sampling techniques to sample 393 households, and compared the direct survey results with benefits estimates derived from an indirect estimation technique.

Survey Design and Management

During the past 15 years, designed and managed large-scale surveys. Experienced in using bidding games, direct-question, contingent-ranking, and discrete-choice techniques for measuring benefits of natural resource and environmental policies. Directed focus groups to determine appropriate terminology, to evaluate the effectiveness of alternative visual aids used in the surveys, and to assess the various survey issues. Developed surveys to evaluate the following:

- Health benefits from reduced cardiac and respiratory morbidity using conjoint analysis
- Market penetration for "green" products using conjoint analysis
- Customer willingness to pay for "greener" electricity using conjoint analysis
- The role of quality-of-life measures in the benefits of improved life extension

- Natural resource damages
- Risk-communication effectiveness
- Radon risk perceptions and willingness to pay to reduce perceived risks
- Benefits of hazardous waste management regulations
- Risk perceptions related to the proposed siting of a nuclear waste repository and willingness to pay to reduce those perceived risks
- Recreation benefits demand
- Recreation, user, and option benefits for different levels of water quality

Environmental Costing

Provided analysis and testimony for the eastern Wisconsin utilities in hearings on environmental costing before the Wisconsin Public Service Commission.

Estimated the environmental externality costs of resource planning options for the eastern Wisconsin utilities and for Northern States Power.

Participated in environmental costing workshop and served on peer review committee for Ontario Hydro.

Health Economics

Conducted focus groups and used verbal protocols to develop stated-preference conjoint survey questionnaires.

Conducted large-scale stated-preference conjoint survey to measure benefits of reduced cardiac and respiratory morbidity.

Designed/conducted pilot study of quality of life and enhanced longevity using conjoint stated-preference methods.

Designed and distributed radon information materials that were sent to 2,000 homeowners in the state of New York who had their homes tested for radon. Supervised interviews with homeowners, sequenced over a nine-month to two-year period, to elicit their perceptions of radon risks and tracked any expenditure decisions to reduce these risks. The expenditures were used to estimate a willingness-to-pay measure of the value of reductions in radon risks. The research design also evaluated the effectiveness of an information policy for reducing radon risks.

Developed and evaluated alternative approaches for encouraging Maryland homeowners to test for radon. Developed and pretested risk communication materials that ranged from radio public service announcements to public display posters and brochures. Used a three-community experimental design with 1,500 baseline and follow-up interviews in each community to measure effectiveness.

Professional Associations

- American Economic Association
- Association of Environmental and Resource Economists (AERE)
- Associate Member, Appraisal Institute
- Member of Nominating Committee for AERE, 1983 and 1986

Honors and Awards

- Recipient, Research Triangle Institute Professional Development Award, 1985
- Nominated for Outstanding Young Man of Rolla, Missouri, 1979
- Outstanding Teacher Award, University of Missouri at Rolla, 1977 to 1979
- Scholar-Diplomat, U.S. State Department, 1978
- Graduated *cum laude*, Stetson University, 1972

Professional Leadership

- Vice President, Association of Environmental and Resource Economists, 1992 to 1994
- Associate Editor, *International Journal of Energy Studies*, 1989 to 1993
- Associate Editor, *Journal of Environmental Economics and Management*, 1992 to 1994
- Associate Editor, *Water Resources Research*, 1984 to 1987

Journals and Book Reviews

- *American Economic Review*
- *Review of Economics and Statistics*
- *Land Economics*
- *Journal of Environmental Economics and Management*
- *Growth and Change*
- *American Journal of Agricultural Economics*
- *Southern Economics Journal*
- *Mansfield's Principles of Microeconomics*
- *Marine Resource Economics*

- *National Science Foundation*
- *Journal of the American Statistical Association*

Publications

- MacNair, D.J. and W.H. Desvousges. Forthcoming. "The Economics of Fish Consumption Advisories: Insights from Revealed and Stated Preference Data." *Land Economics*
- Mathews, K.E., M.L. Freeman, and W.H. Desvousges. Forthcoming. "How and How Much? The Role of Information in CE Questionnaires." In *Using Choice Experiments to Value Environmental Amenities*, Barbara Kanninen, ed. Boston: Kluwer Academic Publishers.
- Kinnell, J.C., M.F. Bingham, A.F. Mohamed, W.H. Desvousges, T.B. Kiler, E.K. Hastings, and K.T. Kuhns. 2006. "Estimating Site-Choice Decisions for Urban Recreators." *Land Economics* 82(2):257–272.
- Dunford, R.W., T.C. Ginn, and W.H. Desvousges. 2004. "The Use of Habitat Equivalency Analysis in Natural Resource Damage Assessments." *Ecological Economics* 48(1):49–70.
- Mathews, K.E., and W.H. Desvousges. 2003. "Stigma Claims and Survey Reliability: Lessons Learned from Natural Resource Damages Litigation." *Journal of Forensic Economics* 16(1):23–36.
- Iannuzzi, T.J., D.F. Ludwig, J.C. Kinnell, J.M. Wallin, W.H. Desvousges, and R.W. Dunford. 2002. *A Common Tragedy: History of an Urban River*. Amherst, MA: Amherst Scientific Publishers.
- Mathews, K.E., K.J. Gribben, and W.H. Desvousges. 2002. "Integration of Risk Assessment and Natural Resource Damage Assessment: A Case Study of Lavaca Bay." In *Human and Ecological Risk Assessment: Theory & Practice*, Dennis J. Paustenbach, ed. New York: John Wiley and Sons.
- Johnson, F.R., R.W. Dunford, W.H. Desvousges, and H.S. Banzhaf. 2001. "The Role of Knowledge in Assessing Nonuse Damages: A Case Study of the Lower Passaic River." *Growth and Change* 32(Winter):43–68.
- Smith, V. Kerry, Donald H. Taylor, Jr., Frank A. Sloan, F. Reed Johnson, and William H. Desvousges. 2001. "Do Smokers Respond to Health Shocks?" *The Review of Economics and Statistics* 83(4):675–687.
- Desvousges, W.H., and J.C. Lutz. 2000. "Compensatory Restoration: Economic Principles and Practice." *Arizona Law Review* 42(2):411–432.
- Johnson, F.R., M.R. Banzhaf, and W.H. Desvousges. 2000. "Willingness to Pay for Improved Respiratory and Cardiovascular Health: A Multiple-Format Stated-Preference Approach." *Health Economics* 9:295–317.

- Payne, J.W., D.A. Schkade, W.H. Desvousges, and C. Aultman. 2000. "Valuation of Multiple Environmental Programs." *Journal of Risk and Uncertainty* 21(1):95–115.
- Desvousges, W.H., F.R. Johnson, and H.S. Banzhaf. 1998. *Environmental Policy Analysis With Limited Information: Principles and Applications to the Transfer Method*. Cheltenham, UK: Edward Elgar.
- Johnson, F.R., W.H. Desvousges, M.C. Ruby, D. Stieb, and P. De Civita. 1998. "Eliciting Stated Health Preferences: An Application to Willingness to Pay for Longevity." *Medical Decision Making* 18(2):57–67.
- Johnson, F.R., and W.H. Desvousges. 1997. "Estimating Stated Preferences With Rated-Pair Data: Environmental, Health, and Employment Effects of Energy Programs." *Journal of Environmental Economics and Management* 34(1):79–99.
- Banzhaf, H.S., W.H. Desvousges, and F.R. Johnson. 1996. "Assessing the Externalities of Electricity Generation in the Midwest." *Resource and Energy Economics* 18:395–421.
- Boyle, K.J., F.R. Johnson, D.W. McCollum, W.H. Desvousges, R.W. Dunford, and S.P. Hudson. 1996. "Valuing Public Goods: Discrete Versus Continuous Contingent-Valuation Responses." *Land Economics* 72(3):381–96.
- Desvousges, W.H., S.P. Hudson, and M.C. Ruby. 1996. "Evaluating CV Performance: Separating the Light From the Heat." In *The Contingent Valuation of Environmental Resources: Methodological Issues and Research Needs*, D.J. Bjornstad and J.R. Kahn, eds. Brookfield, VT: Edward Elgar Publishing Limited.
- Smith, V.K., W.H. Desvousges, and J.W. Payne. 1995. "Do Risk Information Programs Promote Mitigating Behavior?" *Journal of Risk and Uncertainty* 10:203–221.
- Wood, L.L., A.E. Kenyon, W.H. Desvousges, and L.K. Morander. 1995. "How Much Are Customers Willing to Pay for Improvements in Health and Environmental Quality?" *The Electricity Journal* May: 70-77.
- Boyle, K.J., W.H. Desvousges, F.R. Johnson, R.W. Dunford, and S.P. Hudson. 1994. "An Investigation of Part-Whole Biases in Contingent Valuation Studies." *Journal of Environmental Economics and Management* 27(1):64–83.
- Desvousges, W.H., H. Kunreuther, P. Slovic, and E.A. Rosa. 1993. "Perceived Risk and Attitudes Toward Nuclear Wastes: National and Nevada Perspectives." In *Public Reactions to Nuclear Waste*, R. Dunlap, M. Kraft, and E.A. Rosa, eds. Durham, NC: Duke University Press.
- Desvousges, W.H., F.R. Johnson, R.W. Dunford, K.J. Boyle, S.P. Hudson, and K.N. Wilson. 1993. "Measuring Natural Resource Damages With Contingent Valuation: Tests of Validity and Reliability." In *Contingent*

Valuation, A Critical Assessment, J.A. Hausman, ed., pp. 91–164. Amsterdam: Elsevier.

Desvousges, W.H., A.R. Gable, R.W. Dunford, and S.P. Hudson. 1993. "Contingent Valuation: The Wrong Tool for Damage Assessment." *Choices* 8(2):9–11.

Desvousges, W.H., V.K. Smith, and H.H. Rink, III. 1992. "Communicating Radon Risks Effectively: The Maryland Experience." *Journal of Public Policy and Marketing* 11(1):68–78.

Desvousges, W.H., and R.W. Dunford. 1992. "Russian River Basin Formaldehyde Release." In *Natural Resource Damages: Law and Economics*, K.M. Ward and J.W. Duffield, eds. New York: John Wiley and Sons.

Desvousges, W.H., M. Naughton, and G. Parsons. 1992. "Benefits Transfer: Conceptual Problems in Estimating Water Quality Benefits Using Existing Studies." *Water Resources Research* 28(3):675–683.

Kunreuther, H., D. Easterling, W.H. Desvousges, and P. Slovic. 1990. "Public Attitudes Toward Siting a High-Level Nuclear Waste Repository in Nevada." *Risk Analysis* 10(4):469–484.

Smith, V.K., and W.H. Desvousges. 1990. "Risk Communication and the Value of Information: Radon as a Case Study." *Review of Economics and Statistics* 72(1):137–140.

Smith, V.K., W.H. Desvousges, F.R. Johnson, and A. Fisher. 1990. "Can Public Information Programs Affect Risk Perceptions?" *Journal of Policy Analysis and Management* 9(1):41–59.

Desvousges, W.H., and J.H. Frey. 1989. "Integrating Focus Groups and Surveys: Examples from Environmental Risk Studies." *Journal of Official Statistics* 5(4):1–15.

Smith, V.K., and W.H. Desvousges. 1989. "Subjective Versus Technical Risk Estimates: Do Risk Communication Policies Increase Consistency?" *Economic Letters* 31:287–291.

Desvousges, W.H., and V.K. Smith. 1988. "Focus Groups and Risk Communication: The 'Science' of Listening to Data." *Risk Analysis* 8(4):479–484.

Smith, V.K., and W.H. Desvousges. 1988. "Risk Perception, Learning and Individual Behavior." *American Journal of Agricultural Economics* 70(5):1113–1117.

Kunreuther, H., W.H. Desvousges, and P. Slovic. 1988. "Nevada's Predicament: Public Perceptions of Risk From the Proposed Nuclear Waste Repository." *Environment* 30(8):17–20, 30–33.

- Smith, V.K., and W.H. Desvousges. 1988. "The Valuation of Environmental Risks and Hazardous Waste Policy." *Land Economics* 64(3):211–219.
- Smith, V.K., W.H. Desvousges, A. Fisher, and F.R. Johnson. 1988. "Learning About Radon's Risk." *Journal of Risk and Uncertainty* 1:233–258.
- Johnson, F.R., A. Fisher, V.K. Smith, and W.H. Desvousges. 1988. "Informed Choice or Regulated Risks? Lessons From a Social Experiment in Risk Communication." *Environment* 30(4):12–15, 30–35. Reprinted in *Readings in Risk*. 1990. Washington, DC: Resources for the Future.
- Desvousges, W.H., V.K. Smith, A. Fisher, and F.R. Johnson. 1988. "Communicating Radon Risks Effectively." In *Managing Environmental Risks, Proceedings of Air Pollution Control Association, Specialty Conference on Risk Management and Risk Communication*. Pittsburgh, PA.
- Smith, V.K., and W.H. Desvousges. 1987. "An Empirical Analysis of the Economic Value of Risk Changes." *Journal of Political Economy* 95(1):89–114.
- Desvousges, W.H., V.K. Smith, and A. Fisher. 1987. "Option Price Estimates for Water Quality Improvements: A Contingent Valuation Study for the Monongahela River." *Journal of Environmental Economics and Management* 14:248–267.
- Smith, V.K., and W.H. Desvousges. 1986. *Measuring Water Quality Benefits*. Boston: Kluwer Nijhoff.
- Smith, V.K., and W.H. Desvousges. 1986. "Asymmetries in the Valuation for Risk Reductions." *American Economic Review* 76(2):291–294.
- Smith, V.K., and W.H. Desvousges. 1986. "The Value of Avoiding a LULU: Hazardous Waste Landfill Sites." *Review of Economics and Statistics* 68(2):293–299.
- Smith, V.K., and W.H. Desvousges. 1986. "Averting Behavior: Does It Exist?" *Economic Letters* 20:291–296.
- Smith, V.K., W.H. Desvousges, and A. Fisher. 1986. "A Comparison of Direct and Indirect Methods for Estimating Environmental Benefits." *American Journal of Agricultural Economics* 68:280–289.
- Smith, V.K., and W.H. Desvousges. 1985. "The Generalized Travel Cost Model and Water Quality Benefits: A Reconsideration." *Southern Economic Journal* 52(2):371–381.
- Smith, V.K., and W.H. Desvousges. 1984. "Measuring the Benefits of Water Quality Improvements: Additional Considerations." *Southern Economic Journal* October.
- Desvousges, W.H., and M.J. Piette. 1984. "Problems and Prospects: Outer Continental Shelf Petroleum Resources." *Growth and Change* 15(2):3–10.

- Desvousges, W.H. 1984. "Benefit Cost Assessment of the Toulumne River: A Foreword." *Environmental Defense Fund*, Spring.
- Desvousges, W.H., V.K. Smith, and A. Fisher. 1983. "Estimates of the Option Values for Water Quality Improvements." *Economic Letters* 13:81–86.
- Smith, V.K., W.H. Desvousges, and M.P. McGivney. 1983. "Estimating Water Quality Benefits: An Econometric Analysis." *Southern Economic Journal* 50(2):422–437.
- Smith, V.K., W.H. Desvousges, and M.P. McGivney. 1983. "The Opportunity Cost of Travel Time in Recreation Demand Models." *Land Economics* 59(3):259–278.
- Piette, M.J., and W.H. Desvousges. 1981. "Behavior of the Firm: The U.S. Petroleum Pipeline Industry Under Regulatory Constraint." *Growth and Change* 12(2):17–22.
- Garbacz, C., and W.H. Desvousges. 1980. "The Impact of Increased Energy Costs on Municipal Budgets in Missouri." *Missouri Municipal League Review*, July.
- Desvousges, W.H., and M.J. Piette. 1979. "The Effect of 'Large' Mergers on Concentration Trends in Petroleum Production: 1955–1975." *Southern Economic Journal*, October.
- Desvousges, W.H. 1978. *Tourism U.S.A. Volume 1: Appraising Tourism Potential*. United States Department of Commerce, United States Travel Service, Washington, D.C.
- Desvousges, W.H. 1978. "Savannah, Georgia." *Profiles in Tourism U.S.A., 1978*. United States Department of Commerce, United States Travel Service, Washington, D.C.
- Foreyt, J.P., C.E. Rockwood, J.C. Davis, W.H. Desvousges, and R. Hollingsworth. 1975. "Benefit-Cost Analysis of a Token Economy Program." *Professional Psychology* February.

Selected Reports and Working Papers

- The Aluminum Association, BP America, Inc., The Dow Chemical Company, Exxon Mobil Corporation, General Electric Company, and National Mining Association. 2008. "Comments on The United States Department of the Interior's Notice of Proposed Rulemaking on Revisions of Its Type B Procedures for Natural Resource Damage Assessments" (73 Fed.Reg. 11081, February 29, 2008). May 29. (Appendix B: Comments on Proposed Changes to DOI Rule.)
- Desvousges, W.H. and H.J. Michael. 2006. "Response to the Department of the Interior's Questions to FACA Subcommittee #3." Prepared for

Department of the Interior FACA Subcommittee #3. June 2. Raleigh, NC:
W.H. Desvousges & Associates, Inc.

Desvousges, W.H., M.F. Bingham, J.C. Kinnell, A.F. Mohamed, and K.T. Kuhns. 2005. *Review and Response to the EPA's Response to Comments from the American Chemistry Council et al. and Accompanying Triangle Economic Research (TER) Report*. Prepared for the Utility Water Act Group, General Electric Company, American Chemistry Council, American Forest and Paper Association, American Iron and Steel Institute, American Public Power Association, and American Petroleum Institute. April 20. Durham, NC: Triangle Economic Research.

Desvousges, W.H., M.F. Bingham, J.C. Kinnell, and A.F. Mohamed. 2005. *Comments on Potential Nonuse Values for Proposed Phase III Cooling Water Intake Regulations: Final Report*. Prepared for the Utility Water Act Group, American Chemistry Council, American Forest and Paper Association, American Iron and Steel Institute, American Petroleum Institute, and American Public Power Association. January 24. Durham, NC: Triangle Economic Research.

Mathews, K.E., and W.H. Desvousges. 2004. *Stigma Claims and Survey Reliability: Lessons Learned from Natural Resource Damages Litigation*. Working Paper No. T-0401. Durham, NC: Triangle Economic Research.

Bingham, M.F, W.H. Desvousges, and A.F. Mohamed. 2003. *Comments on Benefit Estimation of EPA's Proposed Phase II 316(b) Rule as Summarized in the Notice of Data Availability: Final Report*. Prepared for The Utility Water Act Group. Durham, NC: Triangle Economic Research. June 2.

Mathews, K.E., and W.H. Desvousges. 2002. "The Truth, the Partial Truth, or Anything But the Truth: Survey Reliability and Property Valuation." Paper presented at the Symposium on Environmental & Property Damages: Standards, Due Diligence, Valuation & Strategy, Toronto, Ontario. April 4–6.

Desvousges, W.H., D.M. Clark, M.F. Bingham, A.F. Mohammed, S.M. Small, and D.F. Ludwig. 2002. *Comments on the Benefit Estimates of EPA's Proposed Phase II 316(b) Rule: Final Report*. Prepared for the Utility Water Act Group.

Desvousges, W.H., J.C. Kinnell, K.S. Lievense, and E.A. Keohane. 2001. *Passaic River Study Area Creel/Angler Survey: Data Report*. TER Working Paper No. G-0101. Durham, NC: Triangle Economic Research.

Desvousges, W.H., D.J. MacNair, F.R. Johnson, G.A. Smith, and S.D. Cox. 2000. *Comments on the Federal Trustees' Restoration Scaling and Compensable Value Determination for the Fox River/Green Bay*. Durham, NC: Triangle Economic Research.

- Desvousges, W.H., D.J. MacNair, and G.A. Smith. 2000. *Lower Fox River and Green Bay: Assessment of Potential Recreational Fishing Losses and Restoration Offsets*. Durham, NC: Triangle Economic Research.
- Desvousges, W.H., R.W. Dunford, K.E. Mathews, C.L. Taylor, and J.L. Teague. 1999. *A Preliminary Economic Evaluation of New Jersey's Proposed Groundwater Damage Assessment Process*. Report prepared for New Jersey Site Remediation Industry Network.
- Johnson, F.R., Melissa C. Ruby, William H. Desvousges, and Jonathan R. King. 1998. *Using Stated Preferences and Health-State Classifications to Estimate the Value of Health Effects of Air Pollution*. Report prepared for Environment Canada, Health Canada, Ontario Hydro, and Ontario Ministry of Environment and Energy.
- Desvousges, W.H., F. Reed Johnson, M.C. Ruby, and Alicia R. Gable. 1997. *Valuing Stated Preferences for Health Benefits of Improved Air Quality: Results of a Pilot Study*. TER Working Paper No. T-9702. Durham, NC: Triangle Economic Research.
- Dunford, R.W., W.H. Desvousges, F.R. Johnson, E.E. Fries, H.J. Michael, and K.E. Mathews. 1997. *Comments on NOAA's Draft Compensatory Restoration Guidance Document*. Submitted to National Oceanic and Atmospheric Administration, Silver Spring, MD.
- Dunford, R.W., A.R. Gable, S.P. Hudson, W.H. Desvousges, and F.R. Johnson. 1996. *A Review of the 1996 Contingent Valuation Study on the Value of Preventing Oil Spills Along California's Central Coast*. Prepared for Ad Hoc Industry Group. Durham, NC: Triangle Economic Research.
- Desvousges, W.H., F.R. Johnson, S.P. Hudson, A.R. Gable, and Melissa C. Ruby. 1996. *Using Conjoint Analysis and Health-State Classifications to Estimate the Value of Health Effects of Air Pollution: Pilot Test Results and Implications*. Prepared for Environment Canada, Health Canada, Ontario Hydro, Ontario Ministry of Environment and Energy, and Quebec Ministry of Environment. Durham, NC: Triangle Economic Research.
- Desvousges, W.H., S.M. Waters, and K.E. Train. 1996. *Supplemental Report on Potential Economic Losses Associated with Recreation Services in the Upper Clark Fork River Basin*. Durham, NC: Triangle Economic Research.
- Dunford, R.W., K.E. Mathews, A.R. Gable, E.E. Fries, F.R. Johnson, and W.H. Desvousges. 1995. *Nonuse Values for Nonenvironmental Commodities: Preliminary Contingent Valuation Results for Avoiding Job Losses*. Prepared for the U.S. Department of Energy. Durham, NC: Triangle Economic Research.
- Dunford, R.W., K.E. Mathews, A.R. Gable, E.E. Fries, F.R. Johnson, and W.H. Desvousges. 1995. *Nonuse Values for Nonenvironmental Commodities: Preliminary Conjoint Survey Results*. Prepared for the

U.S. Department of Energy. Durham, NC: Triangle Economic Research.

Gable, A.R., W.H. Desvousges, and F.R. Johnson. 1995. *Calibrating Contingent Valuation Estimates: A Review of the Literature and Suggestions for Future Research*. Prepared for the U.S. Department of Energy. Durham, NC: Triangle Economic Research.

Mathews, K.E., F.R. Johnson, R.W. Dunford, and W.H. Desvousges. 1995. *The Potential Role of Conjoint Analysis in Natural Resource Damage Assessments*. TER Working Paper No. G-9503. Durham, NC: Triangle Economic Research.

Desvousges, W.H. 1995. *The Role of Contingent Valuation in Natural Resource Damage Assessment*. TER Working Paper No. G-9502. Durham, NC: Triangle Economic Research.

Desvousges, W.H., K.E. Mathews, R.W. Dunford, R.R. Russell, and H.L. James. 1995. *Comments on NOAA's Proposed NRDA Rule Under the Oil Pollution Act*. Submitted to NOAA. Durham, NC: Triangle Economic Research.

Desvousges, W.H., K.E. Mathews, R.W. Dunford, R.R. Russell, and H.L. James. 1995. *Comments on NOAA's Proposed NRDA Rule Under the Oil Pollution Act: Executive Summary*. Durham, NC: Triangle Economic Research.

Desvousges, W.H., and R.A. Sandefur. 1995. "Modeling Natural Resource Damages for Spills and Releases of Oils and Chemicals." White Paper prepared for API by Arthur D. Little and Triangle Economic Research.

Desvousges, W.H., L.A. Sturtevant, S.E. Holden, and S.P. Hudson. 1995. *Review of DOI's Proposed NRDAM/CME and Associated Regulations*. Prepared by Arthur D. Little, Inc. and Triangle Economic Research.

Desvousges, W.H., S.P. Hudson, A.R. Gable, and S.K. Snow. 1995. *Review of DOI's Proposed NRDAM/GLE and Associated Regulations*. Prepared by Arthur D. Little, Inc., and Triangle Economic Research.

Desvousges, W.H., F.R. Johnson, H.S. Banzhaf, R.R. Russell, E.E. Fries, K.J. Dietz, S.C. Helms, D. Keen, J. Snyder, H. Balentine, V. Sadeghi, and S.A. Martin. 1995. *Assessing Environmental Externality Costs for Electricity Generation in Wisconsin*. Prepared for Wisconsin Task Force on Externality Costing. Seven volumes. Durham, NC: Triangle Economic Research.

Desvousges, W.H., F.R. Johnson, H.S. Banzhaf, R.R. Russell, E.E. Fries, K.J. Dietz, S.C. Helms, D. Keen, J. Snyder, H. Balentine, V. Sadeghi, and S.A. Martin. 1995. *Assessing Environmental Externality Costs for Electricity Generation*. Prepared for Northern States Power Company. Seven volumes. Durham, NC: Triangle Economic Research.

- Johnson, F.R., W.H. Desvousges, E.E. Fries, and L.L. Wood. 1995. *Conjoint Analysis of Individual and Aggregate Environmental References*. TER Technical Working Paper No. T-9502. Durham, NC: Triangle Economic Research.
- Desvousges, W.H., R.W. Dunford, R.R. Russell, and S.P. Hudson. 1994. *Review of Technical Memorandum: Quantification and Scaling of Resource Services*. Prepared for ASARCO Incorporated, Champion International Corporation, Kaiser Aluminum & Chemical Corporation, Occidental Chemical Corporation, and the City of Tacoma.
- Desvousges, W.H., F.R. Johnson, and H. Spencer Banzhaf. 1994. *Assessing Environmental Costs For Electricity Generation*. TER General Working Paper No. G-9402. Durham, NC: Triangle Economic Research.
- Desvousges, W.H., S.P. Hudson, S.K. Snow, R.W. Dunford, A.R. Gable, M.C. Ruby, and R.A. Sandefur. 1994. *Comments on the National Oceanic and Atmospheric Administration's Natural Resource Damage Assessment Proposed Rule*. Prepared for NOAA. Durham, NC: Triangle Economic Research.
- Desvousges, W.H., L.L. Wood, A.E. Kenyon, F.R. Johnson, R. Iachan, and E.E. Fries. 1994. *Willingness-to-Pay Results and Market Penetration Forecasts*. Prepared for the Electric Power Research Institute.
- Desvousges, W.H., S.P. Hudson, and R.R. Russell. 1993. *Comments on the Department of the Interior's Natural Resource Damage Assessment Proposed Rule*. Prepared for the Office of Environmental Affairs, U.S. Department of the Interior.
- Desvousges, W.H., and F.R. Johnson. 1992. *A Review of "Methods for Measuring Nonuse Values: A Contingent Valuation Study of Groundwater Cleanup,"* by McClelland, Schulze, et al. Prepared for the Environmental Advisory Committee, U.S. Environmental Protection Agency.
- Desvousges, W.H., F.R. Johnson, R.W. Dunford, K.N. Wilson, H.S. Banzhaf, and K.J. Stettler. 1992. *Using Contingent Valuation to Measure Nonuse Damages: An Assessment of Validity and Reliability*. Prepared for the NOAA Contingent Valuation Panel.
- Desvousges, W.H., F.R. Johnson, R.W. Dunford, K.J. Boyle, S.P. Hudson, and K.N. Wilson. 1992. *Measuring Nonuse Damages Using Contingent Valuation: An Experimental Evaluation of Accuracy*. Monograph 92-1, Prepared for Exxon Company, USA. Research Triangle Park, NC: Research Triangle Institute.
- Desvousges, W.H., K.E. Mathews, N. Dean, J.S. Smith, and K.N. Wilson. 1992. *Measuring Benefits of the Effluent Guidelines: An Evaluation of Benefits-Transfer Technique*. Prepared for the Office of Science and Technology, U.S. Environmental Protection Agency.

Desvousges, W.H., F.R. Johnson, J.A. Mauskopf, S.A. Johnston, J.S. Smith, K.N. Wilson, and M. Benerofe. 1991. *Accounting for Externality Costs in Wisconsin Electric Utility Planning*. Prepared for the Wisconsin Public Service Commission.

Desvousges, W.H., and A.J. Milliken. 1991. *An Economic Assessment of Natural Resource Damages from the Arthur Kill Oil Spill*. Prepared for Exxon Company, USA.

Desvousges, W.H., and R.W. Dunford. 1991. *Comments on the Proposed Revision in the NRDA Rule Pursuant to the 1989 Ohio vs. Interior Ruling*. Submitted to the U.S. Department of the Interior.

Robilliard, G.A., W.H. Desvousges, R.W. Dunford, and J. Milliken. 1991. *Natural Resource Injury and Damage Assessment Guidance Manual*. Prepared for the Petroleum Environmental Research Forum.

Regan, M.J., and W.H. Desvousges. 1990. *Communicating Environmental Risks: A Guide to Practical Evaluations*. Prepared for the U.S. Environmental Protection Agency.

Mauskopf, J.A., A. Forrest, and W.H. Desvousges. 1990. *Hazardous Substances in Our Environment: A Citizen's Guide to Understanding Health Risks and Reducing Exposure*. Prepared for the Risk Communication Program, U.S. Environmental Protection Agency.

Regan, M.J., J.L. Creighton, and W.H. Desvousges. 1990. *Sites for Our Solid Wastes: A Guidebook for Effective Public Involvement*. Prepared for the Office of Solid Waste, U.S. Environmental Protection Agency.

Desvousges, W.H., R.W. Dunford, and J.L. Domanico. 1989. *Measuring Natural Resource Damages: An Economic Appraisal*. Prepared for the American Petroleum Institute.

Desvousges, W.H., V.K. Smith, and H.H. Rink, III. 1988. *Communicating Radon Risk Effectively: Radon Testing in Maryland*. Prepared for the Office of Policy, Planning, and Evaluation, U.S. Environmental Protection Agency.

Desvousges, W.H., V.K. Smith, A. Fisher, and F.R. Johnson. 1987. *Communicating Radon Risks Effectively*. Cooperative Agreement report to the Office of Policy Analysis, U.S. Environmental Protection Agency.

Smith, V. Kerry, William H. Desvousges, Ann Fisher, and F. Reed Johnson. 1987. *Radon Risk Perceptions and Risk Communications: Preliminary Results*. Interim report prepared for the Office of Policy Analysis, U.S. Environmental Protection Agency.

Desvousges, W.H., R.W. Dunford, J. Frey, H. Kunreuther, R. Kasperson, and P. Slovic. 1987. *High-Level Nuclear Waste Repository Risks: Focus Group Findings and Implications for Surveys*. Prepared for Mountain West and the State of Nevada.

- Desvousges, W.H., R.W. Dunford, and H.H. Rink, III. 1987. *The Social Cost of a Formaldehyde Release in the Russian River Basin*. Prepared for the U.S. Department of Justice.
- Desvousges, W.H., R.W. Dunford, J. Frey, H. Kunreuther, R. Kasperson, and P. Slovic. 1986. *High Level Nuclear Waste Risk Surveys: Integrated Survey Plan*. Prepared for Mountain West and the State of Nevada.
- Desvousges, W.H., and V.A. Skahen. 1986. *Techniques to Measure Damages to Natural Resources: Final Report*. Prepared for CERCLA 301 Task Force, U.S. Department of the Interior. Durham, NC: Research Triangle Institute.
- Desvousges, W.H., and M.C. Naughton. 1985. *Water Quality Benefits of the BCT Regulations for the Pulp and Paper Industry*. Prepared for the Economic Analysis Division, U.S. Environmental Protection Agency.
- Desvousges, W.H., and V.K. Smith. 1984. *The Travel Cost Approach for Valuing Improved Water Quality: Additional Considerations*. Prepared for the Economic Analysis Division, U.S. Environmental Protection Agency.
- Desvousges, W.H., V.K. Smith, and M.P. McGivney. 1983. *A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements*. Prepared for the Economic Analysis Division, U.S. Environmental Protection Agency.

Selected Presentations

- Desvousges, W.H. 2008. "Natural Resource Damage Assessments: Economic Valuation of Natural Resource Damages." National Advanced Conference on Natural Resource Damages Litigation. Santa Fe, New Mexico. July 18.
- Desvousges, W.H. 2007. "Natural Resource Damage Assessments: Key Economic Issues in Defending a Damages Claim." National Advanced Conference on Natural Resource Damages Litigation. Santa Fe, New Mexico. July 16.
- Desvousges, W.H. 2007. "HEA and Conjoint Analysis Not Ready for Prime Time." Presentation at the U.S. Department of the Interior 2007 NRDA Restoration Program National Workshop. Phoenix, Arizona. April 26.
- Desvousges, W.H. 2006. Presentation at the Office of Policy, Economics and Innovation's National Center for Environmental Economics and the Office of Solid Waste and Emergency Response's Land Revitalization Office workshop on Risk Assessment and Benefit Estimation Methods. Washington, D.C. September 28.

- Desvousges, W.H. 2006. "Response to the Department of the Interior's Questions to FACA Subcommittee #3." Presented to Department of the Interior FACA Subcommittee #3, Shepherdstown, West Virginia, June 5.
- Desvousges, W.H. 2005. "Compensatory Restoration Principles and Practices." Presented at the Natural Resource Damages Seminar, Cook College, New Brunswick, NJ. May 24.
- Desvousges, W.H., and M.F. Bingham. 2004. "Benefit-Cost Analysis and 316(b) Compliance." Presented at the UWAG/EPRI (316(b) Legal Advisory Session, Atlanta, GA. May 12.
- Desvousges, W.H., and K.E. Mathews. 2004. "Evaluating Mass Tort-Class Action Claims for Property Stigma Damages from Environmental Contamination." American Bar Association Conference on Environmental Law, Keystone, Colorado. March 11.
- Kinnell, J.C., M.F. Bingham, E.A. Keohane, and W.H. Desvousges. 2002. "Using Intercept and Count Data to Estimate the Population of Anglers in an Urban and Industrial River." Presented at the 2002 W-133 Conference, Monterey, CA. February.
- Kinnell, J.C., D.J. MacNair, and W.H. Desvousges. 2001. "Using RP and SP Data For Valuing Recreational Access in a Compensatory Restoration Framework." Presented at the 2001 W-133 Conference, Miami, FL. February.
- MacNair, D.J., and W.H. Desvousges. 2001. "Using RP and SP Data to Measure the Effect of Fish Consumption Advisories on Recreational Anglers." Presented at the 2001 W-133 Conference, Miami, FL. February.
- Bingham, M.T., G. Smith, and W.H. Desvousges. 1999. "A Cognitive Approach to Modeling the WTP Decision Under Dichotomous Choice and Open-Ended Contingent-Valuation Survey Formats." Presented at the American Agricultural Economics Association Meeting, Nashville, Tennessee. August.
- Kinnell, J.C., M.F. Bingham, and W.H. Desvousges. 1999. "Sequencing Effects in Valuing Multiple Environmental Programs." Presented at the American Agricultural Economics Association Meeting in Nashville, Tennessee. August.
- Desvousges, W.H., and F.R. Johnson. 1998. "Measuring and Influencing Health-Related Attitudes, Perceptions, and Behavior." August.
- Johnson, F.R., W.H. Desvousges, and M.J. Bingham. 1998. "Trade-off Preferences for Pharmaceuticals Development, Marketing, and Outcome Evaluation." Third international meeting of the International Society for Pharmacoeconomics and Outcomes Research, Philadelphia, PA. May.
- MacNair, D.J., W.H. Desvousges, and J.C. Lutz. 1998. "An In-Kind Damage Assessment of Recreational Fishing Using Revealed and Stated

Preference Data.” The American Agricultural Economics Association Meeting, Salt Lake City, UT. August.

Desvousges, W.H. 1997. “Scaling and Selecting Compensatory-Restoration Projects: An Economic Perspective.” Conference on Restoration of Lost Human Uses of the Environment, Washington, DC. May.

Desvousges, W.H. 1996. “NRDA From an Economist’s Viewpoint.” Blasland, Bouck and Lee, Inc. Sediment Management Seminar, Orlando, FL. February.

Fries, E.E., F.R. Johnson, K.E. Mathews, W.H. Desvousges, and R.W. Dunford. 1996. “The Consistency of Stated Preferences: An Analysis of Salmon-Preservation and Job-Loss Trade-offs.” Camp Resources, Wilmington, N.C. August.

Johnson, F.R., M.C. Ruby, and W.H. Desvousges. 1996. “Valuing Stated Preferences for Health Benefits of Improved Air Quality: Results of a Pilot Study.” Department of Economics at Stockholm School of Economics in Stockholm, Sweden. September.

Desvousges, W.H. 1995. “The Reliability of Contingent Valuation for NRDA.” Panel Presentation at the Southern Economic Association Meetings in New Orleans, LA. November.

Johnson, F.R., W.H. Desvousges, and H.S. Banzhaf. 1995. “Assessing the Externalities of Electricity Generation in the Midwest.” Southern Economic Association Meetings in New Orleans, Louisiana. November.

Desvousges, W.H., S.P. Hudson, and M.C. Ruby. 1994. “Evaluating CV Performance: Separating the Light from the Heat.” DOE/EPA Workshop on Using Contingent Valuation to Measure Nonmarket Values, Herndon, VA. May.

Desvousges, W.H., and S.P. Hudson. 1994. “Contingent Valuation: Is it Accurate Enough for Damage Assessments?” American Bar Association Seminar on Natural Resource Damage Assessments, Chicago, IL. May.

Desvousges, W.H. 1993. “Using Contingent Valuation to Measure Nonuse Damages: A Lesson in Unreliability.” Meeting of the Society for Environmental Toxicology and Chemistry, Houston, TX. November.

Robilliard, G.A., Fischel, W.H. Desvousges, R.W. Dunford, and K.E. Mathews. 1993. “Evaluation of Compensation Formulae to Measure Natural Resource Damages.” International Oil Spill Conference, Tampa, FL. March.

Dunford, R.W., S.P. Hudson, and W.H. Desvousges. 1993. “Experimental Contingent Values for Reducing Environmental Damage from Oil Spills.” International Oil Spill Conference, Tampa, FL. March.

- Desvousges, W.H., R.W. Dunford, K.E. Mathews, and H.S. Banzhaf. 1993. "NRDA Case Study: The Arthur Kill Oil Spill." International Oil Spill Conference, Tampa, FL. March.
- Desvousges, W.H., F.R. Johnson, R.W. Dunford, K.J. Boyle, and S.P. Hudson. 1993. "The Validity of Expressed Nonuse Values for Environmental Commodities." American Agricultural Economics Association meeting, Baltimore, MD. August.
- Desvousges, W.H., F.R. Johnson, R.W. Dunford, K.J. Boyle, S.P. Hudson, and K.N. Wilson. 1992. "Measuring Natural Resource Damages with Contingent Valuation: Tests of Validity and Reliability." Cambridge Economics, Inc., symposium titled, "Contingent Valuation: A Critical Assessment." Washington, DC. April.
- Dunford, R.W., and W.H. Desvousges. 1992. "Oil Spill Liability: Recent Legal and Economic Developments." American Economics Association meeting, New Orleans, LA. January.
- Johnson, F.R., and W.H. Desvousges. 1991. "Nonuse Values in Natural Resource Damage Assessments." Southern Economic Association meeting, Nashville, TN. November.
- Desvousges, W.H. 1991. "Valuing Ecological Risks." National Academy of Sciences Workshop on Ecological Risks, Warrenton, VA. February.
- Dunford, R.W., S.P. Hudson, and W.H. Desvousges. 1991. "Linkages Between Oil Spill Removal Activities and Natural Resource Damages." Presented at the International Oil Spill Conference in San Diego, CA. March.
- Desvousges, W.H. 1990. "Economics and the NRDA: One Economist's View." Workshop on Natural Resource Damages, American Bar Association, Washington, DC. May.
- Desvousges, W.H. 1989. "Risk Perceptions and Nuclear Wastes." Engineering Foundation Conference on Risk Decision-Making, Santa Barbara, CA. October.
- Desvousges, W.H., H. Kunreuther, and P. Slovic. 1989. "Perceived Risk and Nuclear Waste—A National and Nevada Perspective." American Association for the Advancement of Science Annual Meeting, San Francisco, CA. January.
- Desvousges, W.H. 1987. "Hazardous Waste and Radon Risks: Good News and Bad News for Economists." Engineering Foundation Conference on Risk Management, Santa Barbara, CA. November.
- Desvousges, W.H. 1987. "The Use of Focus Groups in Complex Environmental Surveys." American Association of Public Opinion Research Annual meeting, Hershey, PA.

Resume of: **William H. Desvousges**

Smith, V.K., and W.H. Desvousges. 1986. "Information and the Valuation of Risk Reductions," American Economics Association meeting, New Orleans, LA. December.

Desvousges, W.H. 1986. "Methods for Measuring Natural Resource Damages." Conference on Natural Resource Damages, Washington, DC. November.

Smith, V.K., and W.H. Desvousges. 1985. "Values for Risk Reductions: Some Considerations for Siting Decisions." American Economics Association meeting, New York, NY. December.



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Robert Gordon Sproul
Distinguished Professor,
University of California, Berkeley

Postdoctoral Fellowship,
Department of Economics
and Statistics,
University of Chicago

Ph.D., Agricultural and
Resources Economics,
University of California, Davis

AWARDS AND HONORS

Selected as Editor of Annual Review of Resource Economics, 2007-2011

Robert Gordon Sproul Distinguished Professor, University of California, Berkeley, 1986–

College of Natural Resources Citation, University of California, Berkeley, 2004

Galbraith Forum Lecture, 2003

Research Fellow and Member of Research Council, Rural Development Research Consortium,
University of California, Berkeley, 2002

AAAS, Chair of the Electorate Nominating Committee for the Section on Social, Economic, and
Political Sciences, 2001–2002

AAEA Quality of Research Discovery Award, 2001

USDA Secretary of Agriculture Award for outstanding accomplishments in the areas of agricultural
public policy research and formulation, 2000

Senior Economic Consultant, Charles River Associates, 2000-2005

Cofounder and Principle, LECG, Inc., 1990–2000

UC Berkeley, Board of Trustees, 1994-2001

AAEA Fellows Address, 1999

Member, Economic Discipline Board, Fulbright Scholarship Awards, 1989–96

WAEA Outstanding Published Research Award (“Price Distorting Compensation Serving the
Consumer and Taxpayer Interest”), 1994

Member, Board for International Development Studies, Fletcher School of Law and Diplomacy,
Tufts University, 1992–94

Fellow of the American Association for the Advancement of Science, 1993

AAEA Publication of Enduring Quality Award for contributions to environmental economics,
statistical decision theory, and natural resource analysis, 1993

AAEA Distinguished Policy Contribution Award for econometric analysis of public policies, 1993

AAEA Outstanding Journal Article Award Finalist (“Productive and Predatory Public Policies:
Research Expenditures and Producer Subsidies in Agriculture”), 1992

Editor, *Agricultural Management and Economics*, Springer-Verlag, 1988–92

Fellow of the American Statistical Association, 1991

Agency for International Development, Superior Unit Citation Award, 1990

Fellow of the American Agricultural Economics Association, 1990

Special Recognition, “Outstanding Professional Research Contributions.” In Gail L. Cramer and

Clarence W. Jones, *Agricultural Economics and Agribusiness*, 3rd edition, John Wiley and Sons, 1990

Chief Economist, Agency for International Development, 1988–1990

AAEA Outstanding Journal Article Award Finalist (“Incomplete Markets and Government Policy”), 1989

Director: AAEA, university, and departmental Outstanding Dissertations Awards (9), 1979–2005

Chairman, Intergovernmental Consultative Group on Indonesia, The Hague, June, 1989

Cofounder and President of the Institute for Policy Reform, Washington, DC, 1989–1994

Founder of the IPR Fellow Program, 1989

Teaching and course materials in agriculture policy selected for publication in *Economics Reading Lists, Courses, Outlines, Exams, Puzzles, and Problems*, compiled by Edward Tower, Duke University, July 1981

Chairman, Berkeley Department of Economics and All Economic Programs Evaluation Committee, 1987–88

Senior Economist, Council of Economic Advisors, 1986–87

AAEA Award for Best Published Research (“Macroeconomic Linkages, Taxes, and Subsidies in the U.S. Agricultural Sector”), 1986

Editor, *American Journal of Agricultural Economics*, 1983–1986

Resident Fellow, Resources for the Future, National Center for Food and Agricultural Policy, 1984–85

Associate Editor, *Journal of Economic Dynamics and Control*, 1978–1982

Associate Book Review Editor, *Journal of the American Statistical Association*, 1974–1982

AAEA Award for Best Journal Article (“Commodity Price Forecasting With Large-Scale Econometric Models and the Futures Markets”), 1982

AAEA Honorable Mention Award for Best Published Research (“Dynamics of Agricultural Systems: Economic Prediction and Control”), 1980

Editorial Board, *American Journal of Agricultural Economics*, 1977–1980

AAEA Outstanding Journal Article Award Finalist (“Active Learning, Control Theory, and Policy”), 1978

WAEA Award for Best Published Research (“Firm Growth Policies Under Different Pollution Abatement, Production, and Financial Structures”), 1978

Faculty Excellence in Teaching Award, Harvard University, 1978

Associate Editor, *Journal of the American Statistical Association*, 1973–1977

AAEA Award for Best Published Research (“Stochastic Control of Environmental Externalities”), 1976

Commissioned by the AAEA to prepare a monograph, “Systems Analysis and Simulation Techniques,” 1973

Ford Foundation Visiting Scholar, Argentina, 1972

Highest Honors, Ph.D. Degree, University of California, Davis, 1971

Doctoral Dissertation Award for Best Thesis, University of California, Davis, 1971

Other Awards:

Member of Alpha Zeta; Phi Kappa Phi; Blue Key; National Defense and Education Act Fellowship Grant; Blue Key Award for Outstanding Graduate; Greek Man of the Year Award; Alpha Zeta

Alumni Award to the Outstanding Graduating Senior; College Outstanding Leadership Award; Alpha Zeta President; Alpha Gamma Rho President; Agricultural Executive Council President; Senior Class President; Summa Cum Laude.

Listed in:

American Men and Women of Science
Community Leaders of the World
Dictionary of International Biography
Directory of Distinguished Americans
Men of Achievement
Personalities of America
Who's Who in America
Who's Who in American Colleges and Universities
Who's Who in American Education
Who's Who in California
Who's Who in Finance and Business
Who's Who in Finance and Industry
Who's Who in Technology
Who's Who in the West
Who's Who in the World
Who's Who Internationally
Who's Who Among Executives and Professionals

EDUCATION

Postdoctoral Fellowship, University of Chicago, Chicago, IL, 1972–73, Departments of Economics and Statistics

Ph.D., University of California, Davis, 1971, Highest Honors, Agricultural Economics

M.S., University of California, Davis, 1968, Highest Honors, Agricultural Economics

B.S., California State University, Fresno, 1965, Summa Cum Laude, Agriculture and Statistics

ACADEMIC AND GOVERNMENT POSITIONS

1986– Robert Gordon Sproul Distinguished Professor, University of California, Berkeley

1979– Professor of Agricultural and Resource Economics, University of California, Berkeley

1994–00 Dean, College of Natural Resources, University of California, Berkeley

1990–94 President, Institute for Policy Reform

1993–94 Chairman, Department of Agricultural and Resource Economics, University of California, Berkeley

1972–93 Visiting Faculty Appointments

Hebrew University, Israel (1993)

Australian National University (1987)

Monash University, Australia (1987)

Ben Gurion University, Israel (1980)

Hebrew University, Israel (1978)

University of Illinois (1974)

University of Chicago (1972–73)

1988–90 Chief Economist, Agency for International Development, Washington, DC

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- 1986–87 Special Consultant and Senior Staff Economist, Council of Economic Advisors, Washington, DC
- 1984–85 Senior Resident Fellow, Resources for the Future, Washington, DC
- 1979–85 Chairman, Department of Agricultural and Resource Economics, University of California, Berkeley
- 1982–84 Chairman, Executive Committee, Giannini Foundation, University of California, Berkeley
- 1975–78 Professor of Managerial Economics and Statistics, Harvard University
- 1974–75 Professor of Economics and Statistics, Iowa State University
- 1971–74 Full Professor of Agricultural Economics (offered), University of California, Davis (1974)
- Associate Professor of Agricultural Economics, University of California, Davis (1972)
- Assistant Professor of Agricultural Economics, University of California, Davis (1971)

FIELDS OF INTEREST

Agricultural economics
Collective decision-making
Futures and options markets
Industrial organization and antitrust analysis
Law and economics
Applied econometrics

Natural resource and environmental economics
Public policy and economic regulation
Quantitative models
Statistical decision theory
Development economics

MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Academy of Arts and Sciences
American Academy of Political and Social Science
American Agricultural Economics Association
American Association for the Advancement of Science
American Economics Association
American Statistical Association
Econometric Society
Institute of Management Science
International Agribusiness Management Association
International Agricultural Economics Association
Mathematical Association of America
Operations Research Society
Western Agricultural Economics Association

PATENTS

“Analysis and Methodology for Selecting Capital-efficient Film-asset Portfolios,” May 2006

“Integrated Electronic Exchange of Structured Contracts (IEESC) and Dynamic Risk-Based Transaction Permissioning,” Provisional Patent Application, 2001

PUBLICATIONS

Articles in Refereed Journals

“Public-Private Partnerships: Control Rights and the Structure of Contracts” (with Reid Stevens), *Annual Review of Resource Economics* 1, forthcoming.

“Agri-Environmental Programs in the European Union and United States” (with K. Baylis, S. Peplow and L. Simon). *Eurochoices*, forthcoming 2008.

“Unintended Consequences: The Spillover Effects of Common Property Regulations” (with Marty Kovach, Ryan Stifter and Stephen Hamilton). *Marine Policy*, 33(1), 24-39, 2009.

“Pollution and Land Use: Optimum and Decentralization” (with Richard Arnott and Oded Hochman), *Journal of Urban Economics*, 64(2), 390-407, 2008.

“Agri-Environmental Programs in the EU and United States: A Comparison” (with Kathy Baylis, Stephen Peplow and Leo Simon), *Ecological Economics* 65, 753-764, 2008.

“Ownership and Control in Mexico’s Community Forestry Sector” (with C. Antinori). *Economic Development and Cultural Change*, 57(1), 101-136, 2008.

“Public vs. Private Good Research at Land-Grant Universities” (with Leo Simon and Reid Stevens). *Journal of Agricultural and Food Industrial Organization*, 6(2), Article 4, 2008.

“The Role of Patent Rights in Mergers: Consolidation in Plant Biotechnology” (with Alan Marco), *American Journal of Agricultural Economics*, 90 (1) , 133–151, 2008.

“Collective Choice and Community Forest Management in Mexico: an Empirical Analysis” (with Camille Antinori), *Journal of Development Studies*, 43(3): 512-536, 2007.

“General Equilibrium in Vertical Market Structures: Overselling versus Overbuying” (with Richard Just), *Research in Law and Economics*, 23: 149-181, 2007.

“Do Incentives for Quality Matter?” (With Corinne Alexander and Rachael E. Goodhue), *Journal of Agricultural and Applied Economics*, 39(1), 1-15, 2007.

“Does Food Processing Contribute to Childhood Obesity Disparities” (with Bo MacInnis), *American Journal of Agricultural Economics*, 87(5): 1154-8, December 2005.

“Including Non-Trade Concerns: The Environment in EU and U.S. Agricultural Policy,” (with Kathy Baylis and Leo Simon). *International Journal of Agricultural Resources, Governance and Ecology*, Special Issue on Non-Trade Concerns, 4(3/4):262–276, 2005.

“Estimating Statistical Properties of Political Economic Decisions” (with Diana M. Burton and H. Alan Love), *Applied Economics* 36:1489–1499, 2004

“Public-private Partnerships Needed in Horticultural Research and Development” (with Holly Ameden), *California Agriculture* 58(2):116–119, April–June 2004.

“Value Differentiation” (with Rachael Goodhue), *Journal of Agricultural and Resource Economics* 28(3):375–395, December 2003.

“Agricultural Biotechnology’s Complementary Intellectual Assets” (with Gregg Graff and Arthur Small), *Review of Economics and Statistics* 85 (2):349–63, May 2003.

“Stigmatized Asset Value: Is it Temporary or Long-term?” (with Jill J. McCluskey), *Review of Economics and Statistics* 85 (2):276–85, May 2003.

“Hazardous Waste Sites and Housing Appreciation Rates” (with Jill J. McCluskey), *Journal of Environmental Economics and Management* 45:166–76, March 2003.

“Neighborhood Effects and Compensation for Property Value Diminution” (with Jill J. McCluskey and Ray G. Huffaker), *Law & Policy* 24(1):37–50, January 2002.

“Rules, Policy and Rent Seeking: A Cross-border Comparison” (with Kathy Baylis), *Canadian Journal of Agricultural Economics* 49(4):493–504, December 2001.

- “A Bargaining Model to Simulate Negotiations Between Water Users” (with S. Thoyer, S. Morardet, P. Rio, L. Simon and R. Goodhue), *Journal of Artificial Societies and Social Simulation* 4(2), March 2001.
- “Estimation of Perceived Risk and Its Effect on Property Values” (with Jill J. McCluskey), *Land Economics* 7(1):42–55, February 2001.
- “Public-Private Alliances in Biotechnology: Can They Narrow the Knowledge Gaps Between Rich and Poor?” (with Holly Ameden and Leo K. Simon), *Food Policy* 25:499–513, 2000.
- “Regulating Multiple Polluters: Deterrence and Liability Allocation” (with Charles Hyde and Leo K. Simon), *International Economic Review* 41(2):495–521, May 2000.
- “Valuing Research Leads: Bioprospecting and the Conservation of Genetic Resources” (with Arthur A. Small). *Journal of Political Economy* 108(1):173–206, February 2000.
- “Food Import Demand in the Czech Republic” (with Karel Janda and Jill J. McCluskey). *Journal of Agricultural Economics* 51(1):22–44, January 2000.
- “The Political Economy of Public Research Investment and Commodity Policies in Agriculture: an Empirical Study” (with Anurag Banerjee, Harry de Gorter, and Jo Swinnen), *Agricultural Economics* 22:111–122, 2000.
- “Public/Private Research: Knowledge Assets and Future Scenarios,” *American Journal of Agricultural Economics* 81(5):1011–27, 1999.
- “Public/Private Alliances,” *AgBioForum* 2(1):5–10, Winter 1999.
- “Federal Grazing Reform and Avoidable Risk” (with Jill J. McCluskey), *Journal of Agricultural and Resource Economics* 24:140–54, July 1999.
- “Privatization, Market Liberalization and Learning in Transition Economies” (with Rachael E. Goodhue and Leo K. Simon), *American Journal of Agricultural Economics* 80(4):724–37, November 1998.
- “Information Asymmetries, Uncertainties, and Cleanup Delays at Superfund Sites” (with Leo K. Simon and Jinhua Zhao), *Journal of Environmental Economics and Management* 35(1):48–68, January 1998.
- “Central European Agricultural Policy and the EU Accession” (with Rachael E. Goodhue and Leo Simon), *Current Politics and Economics of Europe* 7(1):35–47, 1997.
- “The Estimation of Hicksian and Expenditure Elasticities of Conditional Demand for Food in Transition Economy 1993–1995” (with Karel Janda), *Central European Journal for Operations Research and Economics*, 5(2):155–171, 1997.

- “An Economic Evaluation of BWI Custom Kitchens and Indirect Purchaser Classes in Horizontal Price Fixing Cases” (with Greg Adams), *Competition* 6(1):1–41, Summer 1997.
- “Flexible Public Policy: The Case of the United States Wheat Sector” (with Alan Love) *Journal of Policy Modeling* 19(2):207–236, April 1997.
- “Modelling Multilateral Negotiations: An Application to California Water Policy” (with Gregory D. Adams and Leo K. Simon), *Journal of Economic Behavior and Organization* 30(1):97–111, June 1996.
- “Computable Policy Model of Eastern European Agriculture and the Food Industry” (with Janda, Goodhue, Lyons, and Simon). Prague Economic Papers, *Quarterly Journal of Economic Theory and Policy*, University of Economics, Prague, V (March 96/1), pp. 70–9.
- “Flexible Technology and the Cost of Improving Groundwater Quality” (with David Sunding, David Zilberman, and Alan Marco), *Natural Resource Modeling* 9(2):177–92, Spring 1995.
- “Governance Structures and the Durability of Reforms: Evidence from Inflation Stabilizations” (with Richard Ball). *World Development*, 23(6):897–912, 1995.
- “Government Agricultural Policy, the United States” In: *The Encyclopedia of Agricultural Sciences* 2 (1994) pp. 465–476, Charles J. Arntzen (editor), San Diego, CA: Academic Press.
- “Intraorganizational Influence Relations and the Optimality of Collective Action” (with Pinhas Zusman), *Journal of Economic Behavior and Organization* 24(1):1–22, June 1994.
- “Natural Resource Damages: Knowledge of Valuation Techniques Useful, as Liability Exposure Grows” (with André Fargeix,). *Environmental Compliance & Litigation Strategy* 9 (8):1–5, January 1994.
- “Price Distorting Compensation Serving the Consumer and Taxpayer Interest” (with William E. Foster), *Public Choice* 77(2):275–91, October 1993.
- “The Governance Structure of Agricultural Science and Agricultural Economics: A Call to Arms” (with Richard E. Just) *American Journal of Agricultural Economics* 75:69–83 October 1993.
- “State-Market-Civil Institutions: The Case of Eastern Europe and the Soviet Republics” (with S. R. Johnson), *World Development* 21(4):675–89, April 1993.
- “Nutrient Demand and the Allocation of Time: Evidence from Guam” (with Glynis Gawn, Robert Innes, and David Zilberman). *Applied Economics* 25:811–30, 1993.
- “Environmental and Agricultural Policy Linkages and Reforms in the United States Under the GATT” (with Richard Just). *American Journal of Agricultural Economics* 74(3):766–74, August 1992.

“Predatory Versus Productive Government: The Case of U.S. Agricultural Policy” *Journal of Economic Perspectives* 6(3):133–57, Summer 1992.

“Public Policy and Constitutional Prescription” (with Pinhas Zusman). *American Journal of Agricultural Economics* 74(2):247–57, May 1992.

“Political Preference Functions and Public Policy Reform: Reply” (with William E. Foster), *American Journal of Agricultural Economics* 74(1):227–30, February 1992.

“Productive and Predatory Public Policies: Research Expenditures and Producer Subsidies in Agriculture,” (with Harry de Gorter and David J. Nielson). *American Journal of Agricultural Economics* 74(1):27–37, February 1992.

“Preconditions for the Emergence of East European Market Economies,” *Current Politics and Economics of Europe* 1(3/4):347–61, 1991.

“Farmer Behavior Under Risk of Failure” (with William E. Foster), *American Journal of Agricultural Economics* 73(2):276–88, May 1991.

“Food Security, Price Uncertainty, and Country Hedging: A Case Study of China” (with Jianmin Liu), *The Review of Futures Markets* 10(2):357–371, 1991.

“The Political Economy of Commodity and Public Good Policies in European Agriculture: Implications for Policy Reform” (with Harry de Gorter), *European Review of Agricultural Economics* 18:481–504, 1991.

“Implications of Structural Adjustment: Experience in Developing World for Eastern Europe” *American Journal of Agricultural Economics* 72(5):1252–6, December 1990.

“Market Politics and Foreign Assistance” (with Scott Thomas), *Development Policy Review* 8:365–81, December 1990.

“Linkages Among Commodity Futures Markets and Dynamic Welfare Analysis” (with Nicholas Walraven), *Review of Economics and Statistics* 72(4):631–9, November, 1990.

“Political Preference Functions and Public Policy Reform” (with William E. Foster), *American Journal of Agricultural Economics* 72(3):642–52, August 1990. Reprinted in *Agro-Environmental Policy*, Sandra S. Batie and Rick Horan, eds., Ashgate Publishing Ltd., Aldershot, UK, forthcoming September 2004.

“A New Paradigm for Policy Reform and Economic Development,” *American Journal of Agricultural Economics* 72(3):821–6, August 1990.

“Looking Ahead: Agricultural Policy in the 1990” (with David Nielson), *U.C. Davis Law Review* 12(3):415–30, Spring 1990.

- “An Assessment of the Agricultural Economics Profession” (with Richard E. Just), *American Journal of Agricultural Economics* 1(5):1177–90, December 1989.
- “Incomplete Markets and Government Agricultural Policy” (with Robert D. Innes), *American Journal of Agricultural Economics* 71(4):915–31, November 1989.
- “Interest Rates and Commodity Prices” (with John Kitchen). *Journal of Agricultural Economics Research* 41(2):5–11, Spring 1989.
- “The Political Economy of Agricultural Policy Reform” (with Douglas A. Irwin), *European Review of Agricultural Economics* (1989), pp. 349–66.
- “Managing Farm Supply: Kick the Habit; But Make Other Reforms, Too” (with William E. Foster), *Choices*, 3rd Quarter (1987), pp. 18–21.
- “Modeling the Effects of Policy on Farmers in Developing Agriculture” (with Richard E. Just and David Zilberman), *International Journal of Development Planning Literature* 1(3):287–300, July–September 1986.
- “Macroeconomic Linkages, Taxes, and Subsidies in the U.S. Agricultural Sector” (with James A. Chalfant, H. Alan Love, and Kostas G. Stamoulis) *American Journal of Agricultural Economics* 68(2):399–412, May 1986.
- “Some Political Economy Aspects of Macroeconomic Linkages with Agriculture” (with Margaret S. Andrews), *American Journal of Agricultural Economics* 68(2):413–7, May 1986.
- “The Distributional Effects of Land Controls in Agriculture” (with David Zilberman and Richard E. Just), *Western Journal of Agricultural Economics* 9(2):215–32, December 1984.
- “Country Hedging for Real Income Stabilization: A Case Study of South Korea and Egypt” (with Kathryn M. Gordon), *Journal of Futures Markets* 4(4):449–464, Winter 1984.
- “Systems Science and Natural Resource Economics” (with Stanley R. Johnson and Cleve Willis), *International Journal of Systems Science* 14(8):829–858, 1983.
- “Efficient Asset Portfolios and a Theory of Normal Backwardation” (with Colin Carter and Andrew Schmitz), *Journal of Political Economy* 91(2):319–31, April 1983.
- “The Effect of Asymmetrically Held Information and Market Power in Agricultural Markets” (with Jeffrey M. Perloff), *American Journal of Agricultural Economics* 65(2):366–71, May 1983.
- “Futures Market Efficiency in the Soybean Complex” (with Colin Carter). *Review of Economics and Statistics* 65(3):469–78, August 1983.

- “Political Economic Markets: PERTs and PESTs in Food and Agriculture,” *American Journal of Agricultural Economics* 64(5):821–33, December 1982.
- “Optimal Choices Among Alternative Technologies with Stochastic Yields” (with Joseph Yassour and David Zilberman), *American Journal of Agricultural Economics* 63(4):718–23 November 1981.
- “Multiattribute Utility Analysis: The Case of Filipino Rice Policy” (with Joseph Yassour), *American Journal of Agricultural Economics* 63(3):484–94, August 1981.
- “Commodity Price Forecasting with Large-Scale Econometric Models and the Futures Market” (with Richard E. Just), *American Journal of Agricultural Economics* 63(2):197–215, May 1981.
- “Economics of Soil Conservation from the Farmer’s Perspective,” *American Journal of Agricultural Economics* 62(5):1093–4, December 1980.
- “Hedging and Joint Production, Theory and Illustrations.” *Journal of Finance*, 35(2):498–501, May 1980.
- “Natural Resources, Goods, Bads, and Alternative Institutional Frameworks” (with Harvey Lapan), *Resources and Energy* 2(4):293–324, 1979.
- “Systems Methods in Natural Resource Economics” (with S.R. Johnson and C. Willis), *Cybernetics* 1979.
- “Public Intervention and Producer Supply Response” (with D. Peter Stonehouse). *American Journal of Agricultural Economics* 60(5):885–90, December 1978
- “Active Learning, Control Theory, and Agricultural Policy,” *American Journal of Agricultural Economics* 60(3):476–90, August 1978.
- “Adaptive Control: Survey of Methods and Applications” (with Dov Pekelman). *Management Science* 9:89–120, 1978.
- “Daily Fluctuations in Campground Use: An Economic Analysis” (with Ronald A. Oliveira), *American Journal of Agricultural Economics* 59(2):283–93, May 1977.
- “The Economic Impact of EPA Sulfur Standards on the U.S. Coal Industry” (with R. A. Levins, M. D. Boehlje, and J. A. Otte), *SME Transactions*, 262:65–74, March 1977.
- “The Stability of the Demand for Money in Canada” (with P. Laumas). *Journal of Monetary Economics* 2:367–80, Summer 1976.
- “Investment Sequencing, Allocation, and Learning in the Design of Water Resource Systems: An Empirical Application” (with C. Willis), *Water Resources Research* 12:317–30, June 1976.

- “An Economic Analysis of Wilderness Area Use” (with Ronald A. Oliveira), *Journal of the American Statistical Association* 71(354):276–285, June 1976.
- “Econometric Policy Model Construction: The Post-Bayesian Approach” (with A. Faden), *Annals of Economic and Social Measurement* 5:349–62, Spring 1976.
- “Stochastic Control Theory and Economic Policy: An Application” (with J. W. Freebairn), *Australian Economic Papers* 14(25):216–30, December 1975.
- “Effects and Changes in the Level of U.S. Beef Imports” (with J. W. Freebairn), *American Journal of Agricultural Economics* 57(4):676–688, November 1975.
- “Technical Progress and Environmental Tradeoffs in Natural Resource Industries,” *Journal of Economics and Business* 28:1–14, October 1975.
- “Temporal Price Behavior in Commodity Futures Markets (with T. F. Cargill), *Journal of Finance* 30(4):1043–53, September 1975.
- “The Limitations of Simulation in Model Evaluation and Decision Analysis” (with S. R. Johnson), *Simulation and Games* 6(2):115–50, June 1975.
- “Book Review of The Computation of General Equilibria by Herbert Scarf” (with Quirino Paris). *Journal of the American Statistical Association*, 70(350) (June 1975), pp. 485–86.
- “Stochastic Control of Environmental Externalities” (with R. Howitt), *Annals of Economic and Social Measurement* 4(2):271–92, Spring 1975.
- “Discrete Variations Across Subsets of Parameters in Simultaneous Equation Models” (with S. R. Johnson), *Metroeconomica* 26:226–244, January December 1974.
- “Technological Change, Production, and Investment in Natural Resource Industries,” *American Economic Review* 64(6):1049–59, December 1974.
- “An Adaptive Control Approach to Agricultural Policy”(with J. W. Freebairn), *Australian Journal of Agricultural Economics* 18(3):208–20, December 1974.
- “Estimation of Policy Preference Functions: An Application to U.S. Beef Import Policy” (with J. W. Freebairn), *Review of Economics and Statistics* 56(4):437–49, November 1974.
- “Alternative Econometric Forms,” *Journal of Economics* 2:27–37, October 1974.
- “Updating Parameter Estimates: A Least Squares Approach with an Illustrative Application to the Inventory of Beef Cows” (with J. W. Freebairn), *Review of Marketing and Agricultural Economics* 42(2):83–9, June 1974.

“Approximate Adaptive Control Solutions to U.S. Beef Trade Policy” (with J. W. Freebairn), *Annals of Economic and Social Measurement*, 3(1):177–203, January 1974.

“Sufficient Conditions for Aggregation in Linear Programming Models” (with Quirino Paris), *American Journal of Agricultural Economics*, 55(4):659–66, November 1973.

“The Validity and Verification of Complex System Models: Discussion on Shapiro and Fromm,” (With Carl F. Christ) *American Journal of Agricultural Economics*, 55(2):271–279, May 1973.

“Investment Sequencing Recognizing Externalities in Water Desalting” (with C. Willis), *Water Resource Bulletin*, 9(1):54–72, February 1973.

“Learning External Benefits and Subsidies in Water Desalination” (with C. Willis and P. Frick), *Water Resources Research*, 8(6):1385–400, December 1972.

“Approximate Distribution of Parameters in Distributed Lag Models” (with Theodore P. Lianos), *Journal of the American Statistical Association*, 67(337):64–67, March 1972.

“Time and Frequency Domain Representations of Future Prices as a Stochastic Process” (with Thomas F. Cargill), *Journal of the American Statistical Association*, 67(337):23–30, March 1972.

“Effects of Misspecification of Linear Functions When Sample Values Are Zero or Negative—A Reply” (with S. R. Johnson), *American Journal of Agricultural Economics*, 53(4):673–4, November 1971.

“On the Measurement of Price Elasticity of Demand” (with S. H. Logan and R. A. Oliveira), *American Journal of Agricultural Economics*, 53(1):112–5, February 1971.

“Effects of Misspecifications of Log-Linear Functions When Sample Values Are Zero or Negative” (with S. R. Johnson), *American Journal of Agricultural Economics*, 53(1):120–4, February 1971.

“The Demand for Fertilizer, 1949–1969: An Analysis of Coefficients from Periodic Cross Sections” (with T. F. Moriak), *Agricultural Economics Research*, 22(2):45–56, April 1970.

“The Existence of Broiler Cycles: An Application of Spectral Analysis” (with Thomas F. Cargill), *American Journal of Agricultural Economics*, 52(1):109–21, February 1970.

Papers Submitted for Refereed Journal Publication

“Complementarities and Spillovers in Mergers: An Empirical Investigation Using Patent Data” (with Alan Marco). Submitted to *Economics of Innovation and New Technology*.

“‘Buyer Power’ and Economic Policy: Is Monopsony Really Symmetric with Monopoly?” (with Richard Just). Submitted to *Antitrust Bulletin*.

“John Kenneth Galbraith: The Early Years” (with Susan Stratton). Submitted to *Review of Agricultural Economics*.

“Biotechnology, Intellectual Property and Value Differentiation in Agriculture” (with Rachael Goodhue, Suzanne Scotchmer and Leo K. Simon). Submitted to *Review of Industrial Organization*.

“SSNIP Test: Partial vs General Equilibrium” (with Richard E. Just). Submitted to *Rand Journal of Economics*.

“Predatory Behavior in Vertical Market Structures: A General Equilibrium Approach” (with Richard E. Just). Submitted to *Journal of Law and Economics*.

“Incomplete Information Aggregation Games” (with Leo K. Simon and Jinhua Zhao). Submitted to *Journal of Economic Theory*.

“Processors Placements and Producer Incentives: Analyzing Broiler Chicken Production Contracts” (with Rachael E. Goodhue and Leo K. Simon). Submitted to *Journal of Economic Management Strategy*.

“Price and Location” (with L. Simon), to be submitted to *Journal of Economic Theory*.

“Pollution or Politics: The Case of Environmental Programs in the EU” (with K. Baylis, S. Peplow and L. Simon), to be submitted to *American Economic Journal: Economic Policy*.

“Interactions between Incentive Instruments: Quality Attributes in Processing Tomatoes” (with Rachael E. Goodhue and Sandeep Mohaptra), to be submitted to *The Quarterly Review of Economics*.

“Examining a Potential Link between Diet and Body Mass Index among Young Children” (with Bo MacInnis), to be submitted to *Journal of Health Economics*.

“A Dynamic Model of the Food Processing Sector in the New Market Economies of Central Europe” (with Rachael E. Goodhue, Robert Lyons, and Leo K. Simon), to be submitted to *Journal of Policy Modeling*.

“A Noncooperative Model of Collective Decision Making: A Multilateral Bargaining Approach” (with Leo K. Simon), to be submitted to *Econometrica*.

Books and Monographs

Property Rights and Collective Action in Natural Resources with Application to Mexico (with Antinori). In preparation.

Public/Private Partnerships: Collective Choice Under Alternative Control Premiums.
In preparation.

Political Power and Endogenous Policy Formation (with Jo Swinnen and Pinhas Zusman).
Cambridge University Press, in progress.

Structure and Power in Multilateral Negotiations: An Application to French Water Policy (with Leo K. Simon, Rachael E. Goodhue, Sophie Thoyer, Sylvie Morardet, and Patrick Rio), Giannini Foundation Research Monograph 47, June 2007.

Social Costs of an MTBE Ban in California (with Gregory D. Adams, W. David Montgomery, and Anne E. Smith), University of California, Giannini Foundation Report, December 2004.

Handbook of Agricultural Economics, Vol 2A, Bruce L. Gardner and Gordon C. Rausser (editors), (Amsterdam: Elsevier Science, North-Holland, 2002, 477 pp.).

Handbook of Agricultural Economics, Vol 2B, Bruce L. Gardner and Gordon C. Rausser (editors), (Amsterdam: Elsevier Science, North-Holland, 2002, 562 pp.).

Handbook of Agricultural Economics, Vol 1A, Bruce L. Gardner and Gordon C. Rausser (editors), (Amsterdam: Elsevier Science, North-Holland, 2001, 741 pp.).

Handbook of Agricultural Economics, Vol 1B, Bruce L. Gardner and Gordon C. Rausser (editors), (Amsterdam: Elsevier Science, North-Holland, 2001, 464 pp.).

Agricultural Globalization, Trade and the Environment (with C. Moss, A. Schmitz, T. Taylor, D. Zilberman) (Boston: Kluwer Academic Publisher, 2001, 542 pp.).

GATT Negotiations and the Political Economy of Policy Reform (with associates, eds.), (Berlin, Heidelberg, New York: Springer-Verlag, 1995).

Economic Growth, Political and Civil Liberties (with John McMillan and Stanley R. Johnson), Occasional Paper 53, Institute for Contemporary Studies, San Francisco, 1994.

The Emergence of Market Economies in Eastern Europe (with C. Clague, eds.), (Cambridge, MA: Blackwell Publishers, 1992).

Development and the National Interest (one of many collaborators), Agency for International Development Monograph, March 1989.

Toward Agricultural Policy Reform. Economic Report of the President. Chapter 5, U.S. Council of Economic Advisors, 1987, pp. 147–78.

Macroeconomic Environment for U.S. Agricultural Policy. American Enterprise Institute for Public Policy Research, Occasional Paper on U.S. Agricultural Policy. Washington, DC, 1985.

Alternative Agricultural and Food Policies and the 1985 Farm Bill (with Kenneth R. Farrell, eds.). Giannini Foundation of Agricultural Economics, University of California, Berkeley, and Resources for the Future, Washington, DC, San Leandro, CA: Blaco Publishers, 1984.

New Directions in Econometric Modeling and Forecasting in U.S. Agriculture (editor). (New York: Elsevier North-Holland, Inc., 1982).

Dynamics of Agricultural Systems: Economic Prediction and Control (with E. Hochman). (Amsterdam: North-Holland Publishing Co., 1979).

Urban Malnutrition: Problem Assessment and Intervention Guidelines (with J. Austin, Johanna Dwyer, et al), World Bank Monograph, 1977.

A Survey of Agricultural Economics Literature: Quantitative Methods (with G. G. Judge, R. Day, S. R. Johnson, and Lee Martin), (Minneapolis: University of Minnesota Press, 1977).

In Books and Proceeding Issues

“The Giannini Foundation and the Welfare of California Agriculturalists in a Changing State, Nation, and World.” Submitted for inclusion in (book title) *The Giannini Foundation of Agricultural Economics 75th Anniversary Symposium*, Warren E. Johnson and Alex. F. McCalla, editors.

“University-Private Partnerships in Horticultural R&D”, (with Reid Stevens) in *Transgenic Horticultural Crops: Challenges and Opportunities*, forthcoming.

“Managing R&D Risk in Renewable Energy” (with Maya Papineau), *Transition to a Bioeconomy: Risk, Infrastructure, and Industry Evolution*, B. English, ed. Farm Foundation, forthcoming 2009.

“Negotiating over the Allocation of Water Resources: The Strategic Importance of Bargaining Structure” (with Rachael Goodhue, Leo Simon and Sophie Thoyer), *Game Theory and Policy Making in Natural Resources and the Environment*, Ariel Dinar, Jose Albiac and Joaquin Sanchez-Soriano, editors. Routledge Press, forthcoming 2008.

“Information Asymmetries, Uncertainties, and Cleanup Delays at Superfund Sites” (with Leo Simon and Jinhua Zhao), *The Economics of Hazardous Waste and Contaminated Land*, Hilary Sigman, ed. Edward Elgar Publishing, 2008.

“Estimating Toxic Tort and Damages” (with Mark Berman) in Earl L. Hagström, editor, *Perchlorate: a Scientific, Legal, and Economic Assessment*, Lawyers & Judges Pub. Co., Tucson, AZ, 2006, pp.375-407.

Exploring Frontiers in Applied Economics: Essays in Honor of Stanley R. Johnson, a tribute volume to Stan Johnson; Jean-Paul Chavas and Matt Holt, editors, Berkeley Electronic Press, Berkeley, CA, 2006.

“Agri-Environmental Programs in the United States and European Union” (with Leo Simon and Kathy Baylis) in Anania, M. E. Bohman, C. A. Carter, and A. F. McCalla, editors, *Agricultural Policy Reform and the WTO: Where Are We Heading?*, Edward Elgar, Cheltenham, UK and Northampton, MA, USA, 2004.

“Political Economic Markets: PESTs and PERTs in Food and Agriculture.” In *The WTO and Agriculture*, Kym Anderson and Tim Josling, editors. Edward Elgar Publishing Ltd, Cheltenham, UK & Northampton, MA, USA, 2005.

“Valuing Research Leads: Bioprospecting and the Conservation of Genetic Resources” (with Arthur A. Small). In *The Economics of Biodiversity Conservation*, Stephen Polasky, editor. International Library of Environmental Economics and Policy; Ashgate Publishing Ltd, Aldershot, UK, 2002.

“Mergers and Intellectual Property in Agricultural Biotechnology” (with Alan Marco). In *Economic and Social Issues in Agricultural Biotechnology*, R.E. Evenson, V. Santaniello and D. Zilberman, editors. (New York: CABI Publishing, 2002, pp. 119–35).

“Conceptual Foundations of Expectations and Implications for Estimation of Risk Behavior” (with R.E. Just). In *A Comprehensive Assessment of the Role of Risk in U.S. Agriculture*, Chapter 4, R.E. Just and R.D. Pope, editors. (Boston: Kluwer Academic Publishers, 2001, pp. 53–80).

“Rent Seeking and International Trade in Agriculture” (with Harry de Gorter and Andrew Schmitz). In *Agricultural Globalization, Trade and the Environment*. Chapter 9, C. Moss, G. Rausser, A Schmitz, T. Taylor, D. Zilberman editors. (Boston: Kluwer Academic Publishers, 2001, pp. 179–211).

“Community Integration in Mexico’s Forest Industry: Survey Data from Oaxaca” (with C. Antinori). In: *World Forests, Markets and Policies*. M. Palo, J Uusivuori, and G. Mery, editors. (Boston: Kluwer Academic Publishers, 2001, pp. 293–4).

“Public Research/Private Alignments.” In: *Knowledge Generation and Technical Change: Institutional Innovation in Agriculture*. Chapter 3. (Boston: Kluwer Academic Publishers, 2001, pp. 55–62).

“Production and Marketing” (with R. Goodhue). In: *Handbook of Agricultural Economics*, Volume 1, Chapter 21, Bruce L. Gardner and Gordon C. Rausser (editors). (Amsterdam: Elsevier Science, North-Holland, 2001, pp. 1084–1209).

“Public Policy: Its Many Analytical Dimensions” (with R. Goodhue). In: *Handbook of Agricultural Resource Economics*, Volume 2, Chapter 39, Bruce L. Gardner and Gordon C. Rausser (editors). (Amsterdam: Elsevier Science, North Holland, 2002, pp. 2058–2102).

“Collective Choice in Water Resource Systems.” In: *The Political Economy of Water Pricing Implementation*. The World Bank, Washington, DC. Chapter 3, Ariel Dinar, editor. (New York: Oxford University Press, 2000, pp. 49–78).

“Alignment of Public/Private Institutions in the Biotechnology Revolution” in *Agricultural Outlook Forum 1999 Proceedings*. (Washington, DC: USDA, June 1999).

“Value Differentiation in Agriculture: Driving Forces and Complementarities” (with R. Goodhue). In *Vertical Relationships and Coordination in the Food System*. Giovanni Galizzi and Luciano Venturini, editors. (Heidelberg: Physica-Verlag Publishers, 1999).

“An Empirical Study of the Determinants of Public Research Investment and Commodity Policies in Agriculture” (with Johan F.M. Swinnen, Harry de Gorter, and Anurag N. Banerjee). In *Food Security, Diversification, and Resource Management: Refocusing the Role of Agriculture.* XXIII International Conference of Agricultural Economists. (Sacramento, CA: August 1997).

“The Choice of Commodity Policies and Research Investment in Agriculture” (with Johann F.M. Swinnen and Harry de Gorter). Contributed paper in the Proceedings of the conference, *Global Agricultural Science Policy for the Twenty-First Century*, Melbourne, Australia, August 16–18, 1996.

“The Economic Value of Patents, Licenses, and Plant Variety Protection” (with Arthur A. Small). In proceedings volume, *Building Partnerships for Commercializing University Research*, Tahoe City, California, May, 1996.

“GATT Agricultural Policy Reform: A United States Perspective.” In *Agricultural Markets: Mechanisms, Failures and Regulations*, Martimort, D. (editor). (Amsterdam: Elsevier Science, 1996, pp. 331–71).

“Political Economic Processes and Collective Decision Making” (with Leo K. Simon and Klaas T. van ’t Veld). In *Agricultural Competitiveness: Market Forces and Policy*, Peters, George H. and Hedley, Douglas D. (eds.) Aldershot, Hants, England and Brookfield, Vt., USA: Dartmouth, 1995, pp. 261–273.

“State-Market-Civil Institutions: The Case of Eastern Europe and the Soviet Republics” (with Stanley R. Johnson). In *State, Market and Civil Organizations*, Alain de Janvry, Samir Radwan, Elisabeth Sadoulet and Erik Thorbecke (editors). (London: Macmillan Press, 1995, pp. 458–86).

“The Uruguay Round and the GATT Negotiations.” In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 1, Gordon C. Rausser (editor). (Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 1–34).

“Compensation and Political Feasibility: Facilitating Welfare Improving Policies” (with Richard E. Just and David Zilberman. In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 3, Gordon C. Rausser (editor). Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 65–84.

“The Political Economy of Redistributive Policies and the Provision of Public Goods in Agriculture” (with Harry de Gorter and David J. Nielson). In *GATT Negotiations and the*

Political Economy of Policy Reform, Chapter 4, Gordon C. Rausser (editor). Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 85–106).

“Coalition Breaking and Policy Reform” (with William E. Foster). In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 5, Gordon C. Rausser (editor). Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 107–24).

“Public Goods and Welfare Transfer Tradeoffs” (with William E. Foster). In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 6, Gordon C. Rausser (editor). (Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 125–43).

“Mobility, Diversification, and Sustainability of Trade Reform” (with William E. Foster and Richard Gray). In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 7, Gordon C. Rausser (editor). (Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 145–64).

“Modeling Policy Reform in the U.S. Wheat and Feed Grain Sectors” (with Richard E. Just and David Zilberman). In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 8, Gordon C. Rausser (editor). (Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 175–254).

“The Determination of Technology and Commodity Policy in the U.S. Dairy Industry” (with Harry de Gorter and David Nielson). In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 9, Gordon C. Rausser (editor). (Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 253–74).

“Modeling Phased Reductions of Distortionary Policies in the U.S. Wheat Market under Alternative Macroeconomic Environments” (with Steve Labson). In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 10, Gordon C. Rausser (editor). (Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 275–314).

“Alternative Subsidy Reduction Paths: The Role of Fiscal and Monetary Policy Linkages” (with Pier-Giorgio Ardeni). In *GATT Negotiations and the Political Economy of Policy Reform*, Chapter 11, Gordon C. Rausser (editor). (Berlin, Heidelberg, New York: Springer-Verlag, 1995, pp. 315–45).

“Disruption and Continuity in Bulgarian Agrarian Reform” (with R. F. Lyons and L.K. Simon). In *Privatization of Agriculture in New Market Economies: Lessons from Bulgaria*, Chapter 5, A. Schmitz, K. Molton, A. Buckwell, and S. Davidola (editors). (Boston: Kluwer Academic Publishers, 1994).

“Productive and Predatory Public Policies: Research Expenditures and Producer Subsidies in Agriculture.” Reprinted in *Agricultural Economics*, G. H. Peters (editor). (Cheltenham, England: Edward Elgar Publishing Ltd., 1994).

“International Impacts of Reduced Intervention in Agricultural Markets.” In *International Agricultural Trade and Market Development Policy in the 1990s*, John W. Helmuth and Don F. Hadwiger (editors). (Westport, CT: Greenwood Press, 1993, pp. 81–114).

“Managing Groundwater Quality under Uncertainty” (with David Sunding, David Zilberman, and Alan Marco). In *Quantifying Long-Run Risks in Agriculture*, Michele Marra (editor), proceedings of a seminar sponsored by Southern Regional Project S-232, Jekyll Island, GA, March, 1993. Department of Resource Economics and Policy, University of Maine, Orono, June 1993, pp. 1–33.

“An Emerging Framework for Economic Development: A LDC Perspective.” In *Industrial Policy for Agriculture in the Global Economy*, S.R. Johnson and S. A. Martin (editors). (Ames, IA: Iowa State University Press, 1993, Chapter 11, pp. 229–45).

“The Structure of Research and Transfer Policies in International Agriculture (with David R. Lee).” In *Issues in Agricultural Development, Sustainability and Cooperation*, Margot Bellamy and Bruce Greenshields (editors). International Association of Agricultural Economists Occasional Paper 6, 1992, pp. 34–42.

“Environmental and Agricultural Policy Linkages and Reforms in the United States under the GATT” (with Richard Just and David Zilberman). In *Improving Agricultural Trade Performance under the GATT*, Chapter 18, T. Becker, R. Gray, and A. Schmitz (editors). (Wissenschaftsverlag Vauk Kiel KG, 1992).

“The Political Economy of Transition in Eastern Europe: Packaging Enterprises for Privatization” (with Leo K. Simon). In *The Emergence of Market Economies in Eastern Europe*, Chapter 14, Christopher Clague and Gordon Rausser (editors). (Cambridge, MA: Blackwell Publishers, 1992, pp. 245–70).

“Lessons for Emerging Market Economies in Eastern Europe.” In *The Emergence of Market Economies in Eastern Europe*, Chapter 19, Christopher Clague and Gordon Rausser (editors). Cambridge, MA: Blackwell Publishers, 1992, pp. 311–32).

“An Assessment of the Agricultural Economics Profession.” In *Social Science Agricultural Agendas and Strategies*, Chapter 7, J. Loehr (editor). (East Lansing, MI: Michigan State University Press, 1991).

“The Political Economy of Agriculture in the United States.” In *The Political Economy of North America Agricultural Policies and Trade*, Chapter 3, Hans Michelmann, Jack Stabler, and Gary Storey (editors). (Boulder, CO: Westview Press, 1991, pp 57–91).

“Public Research in Agriculture: An Alternative Institutional Framework” (with David Zilberman). In *Economic Models, Estimation, and Socioeconomic Systems: Essays in Honor of Karl Fox*, Tej K. Kaul and Jati K. Sengupta (editors). (Amsterdam: Elsevier Science Publishers, 1991, pp. 33–53).

“Organizational Failure and the Political Economy of Water Resources Management” (with Pinhas Zusman). In *The Economics and Management of Water and Drainage in Agriculture*, Chapter 37, Ariel Dinar and David Zilberman (editors). (Boston: Kluwer Academic Publishers, 1991, pp. 735–58).

“The Evolution and Coordination of U.S. Commodity and Resource Policies” (with William E. Foster). In *Commodity and Resource Policies in Agricultural Systems*, Richard E. Just and Nancy Bockstael (editors). (Berlin, Heidelberg, New York: Springer-Verlag, 1991, pp. 17–45).

“Dynamic Welfare Analysis and Commodity Futures Markets Overshooting” (with Nicholas Walraven). In *International Commodity Market Modelling: Advances in Methodology and Applications*, Chapter 11, O. Guvenen, W.C. Labys, and J.-B. Lesourd (editors). (London: Chapman and Hall Book Publishing Company, 1991, pp. 211–32).

“Empirical Pricing Measures for Futures Markets” (with Nicholas Walraven). In *Commodity Futures and Financial Markets*, Chapter 7, Louis Philips (editor). (Boston: Kluwer Academic Publishers, 1990, pp. 179–203).

“The Politics of Economic Policy Reform” (with E. Scott Thomas). In *Development Issues, 1990*, Chapter 2, Ronald Roskens, Chairman of Development Coordination Committee (editor). (Washington, DC: U.S. Government Printing Office, 1990, pp. 4–19).

“World Commodity Prices: The Role of External Debt and Industrial Country Policies” (with M.G. Rose and D.A. Irwin). In *Agricultural Trade Liberalization*, Chapter 15, Ian Goldin and Odin Knudsen (editors). (Paris: Organization for Economic Cooperation and Development; and Washington: The World Bank, 1990, pp. 415–45).

“Endogenizing Policy in Models of Agricultural Markets” (with Harry de Gorter). In *Agriculture and Governments in an Interdependent World*, Allen Maunder and Alberto Valdés (editors). Proceedings of the Twentieth International Conference of Agricultural Economists, Buenos Aires, August, 1988. (Dartmouth: International Association of Agricultural Economists, University of Oxford, 1989, pp. 259–74).

“The Macroeconomic Dimension of Agricultural and Food Policy Reform.” In *World Food System: Hunger in the Midst of Plenty, Volume II*, John W. Helmuth and Stanley R. Johnson (editors). (Ames, IA: Iowa State University Press, 1989, pp. 90–109).

“The Impacts of Economic Reform for Agricultural and Food Policy” (with William E. Foster). In *World Food System: Hunger in the Midst of Plenty, Volume I*, John W. Helmuth and Stanley R. Johnson (editors). (Ames, IA: Iowa State University Press, 1989, pp. 95–99).

“Alternative Strategies for Trade Policy Reform” (with Brian D. Wright). In *Policy Coordination in World Agriculture*, Harald von Witzke, C. Ford Runge, and Brian Job (editors). (Minneapolis: University of Minnesota Press, 1989, pp. 117–159).

“A Coherent Policy for U.S. Agriculture” (with William E. Foster). In *Food, Policy, and Politics: A Perspective on Agriculture and Development*, George Horwich and Gerald J. Lynch (editors). (Boulder, CO: Westview Press, 1989, pp. 191–237).

“Developments in Economics of Importance to Agricultural Economics: A Discussion.” In *Agriculture and Rural Areas Approaching the 21st Century*, R. J. Hildreth et al (editors). (Ames, IA: Iowa State University Press, 1988, pp. 257–264).

“The Macroeconomics of Agriculture in Rural America.” In *Agriculture and Rural Areas Approaching the 21st Century*, R. J. Hildreth et al (editors). (Ames, IA: Iowa State University Press, 1988, pp. 384–395).

“Stability Issues and Policy Analysis.” In *Agricultural Stability and Farm Programs*, Dan Sumner (editor). (Boulder, CO: Westview Press, February, 1988, pp. 143–170).

“Overshooting of Agricultural Prices” (with Kostas G. Stamoulis). In *Macroeconomics, Agriculture, and Exchange Rates*, P. L. Paarlberg and Robert G. Chambers (editors). International Agricultural Trade Research Consortium. (Boulder, CO: Westview Press, 1988, pp. 163–189).

“The Food Marketing System: The Relevance of Economic Efficiency Measures” (with Jeffrey M. Perloff and Pinhas Zusman). In *Economic Efficiency in Agricultural and Food Marketing*, Richard L. Kilmer and Walter J. Armbruster (editors). (Ames, IA: Iowa State University Press, 1987, Chapter 1, pp. 3–31).

“Modeling the Effects of Policy on Farmers in Developing Agriculture” (with Richard E. Just and David Zilberman). Chapter published in *Theoretical Foundations of Development Planning*. S.B. Dahiya (ed); foreword by Professor Jan Tinbergen, Nobel Laureate. (Delhi, India: Vedams Books International, Concept Publishing Company, 1992. [Originally appeared in *International Journal of Development Planning Literature* 1(3), (July September, 1986), pp. 287–300.]

“Modeling Alternative Trade and Macroeconomic Scenarios: Implications for U.S. Agriculture” (with Kostas G. Stamoulis, H. Alan Love, and James A. Chalfant). In *Impacts of Farm Policy and Technological Change on U.S. and California Agriculture*. Harold O. Carter (editor). (Davis, CA: University of California, Agricultural Issues Center, 1986, pp. 91–136).

“Instability in Agricultural Markets: The U.S. Experience” (with James A. Chalfant and Kostas G. Stamoulis). In *Agriculture in a Turbulent World*, A. Maunder and U. Renborg (editors). (Oxford: Oxford University Press, 1985, Chapter 6, pp. 595–604).

“A Synthesis of Major Studies and Options for 1984” (with William E. Foster). In *The Dilemmas of Choice*, Chapter 7, Kent A. Price (editor). (Washington, DC: The National Center for Food and Agricultural Policy, Resources for the Future, 1985, pp. 201–46).

“Macroeconomics and U.S. Agricultural Policy.” In *U.S. Agricultural Policy: 1985 Farm Legislation*, Bruce L. Gardner (editor). (Washington, DC: American Enterprise Institute for Public Policy Research, 1985, pp. 207–52).

“Review and Assessment of Alternative Agricultural Policy Proposals” (with Linda S. Calvin and William E. Foster). In *Alternative Agricultural and Food Policies and the 1985 Farm Bill*, Chapter 7, Gordon C. Rausser and Kenneth R. Farrell (editors). Giannini Foundation of

Agricultural Economics, University of California, Berkeley, and Resources for the Future, Washington, DC, San Leandro, CA: Blaco Publishers, 1984, pp. 143–82).

“Uncertain Economic Environments and Conditional Policies” (with Richard E. Just). In *Alternative Agricultural and Food Policies and the 1985 Farm Bill*, Chapter 5, Gordon C. Rausser and Kenneth R. Farrell (editors). Giannini Foundation of Agricultural Economics, University of California, Berkeley, and Resources for the Future, (Washington, DC, San Leandro, CA: Blaco Publishers, 1984, pp. 101–32).

“Summary and Conclusions” (with Kenneth R. Farrell). In *Alternative Agricultural and Food Policies and the 1985 Farm Bill*, Chapter 1, Gordon C. Rausser and Kenneth R. Farrell (editors). Giannini Foundation of Agricultural Economics, University of California, Berkeley, and Resources for the Future, Washington, DC, San Leandro, CA: Blaco Publishers, 1984, pp. 1–8.

“Monetary Policy and U.S. Agriculture” (with John W. Freebairn and Harry de Gorter). In *International Agricultural Trade: Advanced Readings in Price Formation, Market Structure, and Price Instability*, Andrew Schmitz, and Alexander H. Sarris (editors). (Boulder, CO: Westview Press, 1984, pp. 99–123).

“Agricultural Policy: A Synthesis of Major Studies and Options for 1985” (with William E. Foster). National Conference on Food, Agriculture, and Resources, Resources for the Future. (Washington, DC, 1984, p. 120.

“A Proper Perspective for Considering Adaptive Economics” (with David Zilberman). In *Modeling Farm Decisions for Policy Analysis*, Kenneth H. Baum and Lyle P. Schertz (editors). (Boulder, CO: Westview Press, 1983, pp. 56–60).

“Implications of United States Experience for Water Resource Planning in Egypt” (with Margriet F. Caswell). In *The Economic Challenges of Peace: Agriculture and Economic Transition in Egypt*. Proceedings of a Conference, Alexandria, Egypt, 1980, S. R. Johnson, John R. Moore, and Martin Wannan (editors). (Columbia, MO: University of Missouri, Department of Agricultural Economics, 1983, pp. 48–64).

“Expectation and Intertemporal Pricing in Commodity Futures and Spot Markets” (with Richard E. Just). In *Applied Commodity Price Analysis, Forecasting, and Market Risk Management: Proceedings of the NCR-134 Conference*, Des Moines, Iowa, 1983. (Ames, IA: Iowa State University, Department of Agricultural Economics, 1983, pp. 252–79).

“Modeling Equity and Efficiency in Agricultural Production Systems” (with Richard E. Just and David Zilberman). In *Growth and Equity in Agricultural Development*; Proceedings, 18th International Conference of Agricultural Economics, Jakarta, Indonesia, 1982, A. Maunder and K. Ohkawa (editors). Aldershot: Gower, 1983, and (Oxford: Oxford University Press, 1983, pp. 120–35).

“Lead-Lag Price Relationships Between Thinly and Heavily Traded Commodity Futures Markets” (with Colin A. Carter). In *Applied Commodity Price Analysis, Forecasting, and Market*

Risk Management: Proceedings of the NCR134 Conference, Des Moines, Iowa, 1983. (Ames, IA: Iowa State University, Department of Agricultural Economics, 1983, pp. 241–51).

“Commodity Price Forecasting with Large-Scale Econometric Models and the Futures Market.” Reprinted in *Readings and Futures Markets, IV: Selected Writings on Futures Markets: Research Directions in Commodity Markets, 1970–1982*, Chicago Board of Trade, 1983.

“The Distributional Impacts of Agricultural Programs” (with David Zilberman and Richard E. Just). In *Proceedings from Perspectives on Food and Agricultural Policy Research Workshop*. (Oak Brook, IL: The Farm Foundation, 1982, pp. 33–60).

“Principles of Policy Modeling in Agriculture” (with Richard E. Just). In *Modeling Agriculture for Policy Analysis in the 1980s*. (Kansas City: Federal Reserve Bank of Kansas City, September, 1981, pp. 139–74). Also in *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*. (New York: Elsevier North-Holland, Inc., 1982, pp. 763–800).

“Institutionalizing a Large Scale Econometric Model: The Case of Agricultural Canada” (with Stanley R. Johnson and Bruce Huff). In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 23, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 801–30).

“Composite Forecasting in Commodity Systems” (with Stanley R. Johnson). In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 21, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 719–62).

“Structural Change, Updating, and Forecasting” (with Yair Mundlak and Stanley R. Johnson). In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 20, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 659–718).

“Developments in Theory and Empirical Applications of Endogenous Governmental Behavior” (with Erik Lichtenberg and Ralph Lattimore). In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 18, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 547–614).

“Food and Agriculture Sector Linkages to the International and Domestic Macroeconomies” (with John W. Freebairn and Harry de Gorter). In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 17, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 503–46).

“Price Supports and Demand in Commodity Market Modeling” (with Chris Riboud). In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 11, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 319–42).

“Consumer Demand, Grades, Brands, and Margin Relationships” (with Peter Berck). In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 4, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 99–130).

“New Conceptual Developments and Measurements for Modeling the U.S. Agricultural Sector.” In *New Directions in Econometric Modeling and Forecasting in U.S. Agriculture*, Chapter 1, Gordon C. Rausser (editor). (New York: Elsevier North-Holland, Inc., 1982, pp. 1–14).

“Simple Quantitative Models for Integrative Planning Frameworks.” In *Planning and Decision in Agribusiness: Principles and Experiences*, C.H. Hanf and G.W. Schiefer (editors). (New York: Elsevier Scientific Publishing Company, 1982, pp. 335–69).

“Food Grain Policy in Bangladesh.” In *Planning and Decision in Agribusiness: Principles and Experiences*, C.H. Hanf and G.W. Schiefer (editors). (New York: Elsevier Scientific Publishing Company, 1982, pp. 241–62).

“Principal Issues in the Evaluation of Public Research in Agriculture” (with Alain de Janvry, Andrew Schmitz, and David Zilberman). In *Methodology for Evaluation of Agriculture Research*, Walter L. Fishel, G.W. Norton, A. Paulsen, and W. Burt Sunquist (editors). (Minneapolis: University of Minnesota, Agricultural Experiment Station, 1981, Miscellaneous Publication No. 8.

“Policy: Alternatives and Consequences of Conservation Technology on Agricultural Land.” In *Soil and Water Resources: Research Priorities for the Nation*, W.E. Larsen, L.M. Walsh, B.A. Stewart, and Don H. Boelter (editors). (Madison, WI: Soil Science Society of America, 1981, pp. 83–102).

“A Putty-Clay Approach to the Distributional Effects of New Technology Under Risk” (with Richard E. Just and David Zilberman). In *Operations Research in Agriculture and Water Resources*, Chapter 6, Dan Yaron and Charles Tapiero (editors). (Amsterdam: North-Holland Publishing Co., 1980, pp. 97–121).

“Prospects and Limitations of Operations Research Applications in Agriculture and Agricultural Policy” (with Richard E. Just and David Zilberman). In *Operations Research in Agriculture and Water Resources*, Chapter 2, Dan Yaron and Charles Tapiero (editors). (Amsterdam: North-Holland Publishing Co., 1980, pp. 17–40).

“The Israeli Poultry Marketing Board: Price Production and Inventory Controls” (with Eithan Hochman and Eliahu Comay). In *Applied Stochastic Control in Econometrics and Management Science*, Chapter 1, A. Bensoussan, P. Kliendorfer, and C. S. Tapiero (editors). (Amsterdam: North-Holland Publishing Co., 1980, pp. 1–38).

“Futures Versus Commercial Econometric Models” (with Richard E. Just). In *Futures Trading Seminar*, Anne Peck (editor). (Chicago: Board of Trade of the City of Chicago, 1980, p. 6).

“Models of the U.S. Corn System.” In *Agribusiness Management for Developing Countries—Southeast Asia Corn Systems*, R. A. Goldberg et al (editors). (Boston: Ballinger Publishing Co., 1979, pp. 576–626).

“A Survey of Systems Analysis and Simulation in Agricultural Economics” (with S.R. Johnson). In *1940s to 1970s*, Chapter 3, G.G. Judge et al (editors). (Minneapolis: University of Minnesota Press, 1977, pp. 156–301).

“Firm Growth Policies Under Different Pollution Abatement, Production, and Financial Structures” (with E. Hochman). In *Economic Growth of the Agricultural Firm*, Chapter 12, C. Baker and R. Barry (editors). (Pullman, WA: Washington State University Press, WRCC-16 Research Committee, 1977).

“Environmental Impacts on Electricity Systems Growth” (with A.S. Cohen and G. Fishelson). In *Environmental Pollutants and the Urban Economy*, G.S. Tolley and A.S. Cohen (editors). (Chicago: University of Chicago, Center for Urban Studies, 1976).

“Environmental Policies for Power Plants” (with G. Fishelson and A.S. Cohen). In *Environmental Pollutants and the Urban Economy*, G.S. Tolley and A.S. Cohen (editors). (Chicago: University of Chicago, Center for Urban Studies, 1976).

“Economic Forecasting: The Case of Australian Agriculture” (with J. W. Freebairn). *American Statistical Association Proceedings*, Business and Economic Section (September, 1976), pp. 5425–48.

“An Estimating Method for Models with Stochastic, Time Varying Parameters” (with S. R. Johnson). *American Statistical Association Proceedings*, Business and Economic Statistics Section (September 1975), pp. 356–61.

“Normalization Rules, Approximate Small Sample Properties and the TSLS Estimator” (with S. R. Johnson). *American Statistical Association Proceedings*, Business and Economic Statistics Section (December 1972), pp. 420–25.

“Uncertainty and Decision-Making in Water Resources” (with G. W. Dean). In *California Water: A Study in Resource Management*, Chapter 12, D. Seckler (editor). (Berkeley: University of California Press, 1971, pp. 233-50 and pp. 310-344).

“An Appendix on Water Resource Decision Making Under Conditions of Uncertainty” (with G. W. Dean). In *California Water: A Study in Resource Management*, D. Seckler (editor). (Berkeley: University of California Press, 1971, pp. 310–44).

“Forecasting Weekly Lemon Prices by a Distributed Lag Model with Fourier Transform Methods” (with Dean Chen). *American Statistical Association Proceedings*, Business and Economic Statistics Section (December 1970).

“A General Framework for Aggregation in Linear Programming Models” (with Quirino Paris). *Western Agricultural Economics Association Proceedings* (July 1970).

“A Time Series Analysis of the U.S. Hog Industry.” *Western Agricultural Economics Association Proceedings* (July 1969).

“Futures Price Behavior as a Stochastic Process” (with T. F. Cargill). *American Statistical Association Proceedings*, Business and Economic Statistics Section (August 1969).

Commissioned Papers, Governmental Reports, and Panel Discussion Papers

“Multifunctionality in the EU: pollution or politics? Implications for Canadian Trade” (with K. Baylis, S. Peplow and L. Simon). Report for Agriculture and Agri-Food Canada, December 2005.

“Agri-environmental Policy in the European Union: Who’s in Charge?” (Kathy Baylis and Leo Simon). CATPRN Commissioned Paper CP 2006-4. (synopsis) www.catprn.org

“Agri-Environmental Programs in the United States and European Union” (Kathy Baylis and Leo Simon). Feedinfo 2005 <http://www.feedinfo.com>

“Fueling the Research Engine.” *California Monthly*, 109(5), April 1999.

“Private/Public Research: Knowledge Assets and Future Scenarios. Annual meeting of the American Agricultural Economics Association, Nashville, TN, August 1999.

“Agricultural Trade Liberalization and Capital Flows in the Americas” (with James Reitzes, Roger Hickey, and Jeremy Arnone). Center for Agricultural and Rural Development, GATT Paper 96–GATT 2, December 1997.

“The Judgment Proof Opportunity” (with Klaas van ’t Veld and Leo K. Simon). Discussion paper presented at the 2nd Toulouse Conference on Environmental Economics, Fondazione Eni Enrico Mattei Working Paper No. 83.97, May 1997.

“Information Asymmetries, Uncertainties, and Cleanup Delays at Superfund Sites” (with Leo K. Simon and Jinhua Zhao). Discussion paper presented at the 2nd Toulouse Conference on Environmental Economics, Fondazione Eni Enrico Mattei, Institut d’Economie Industrielle and INFRA, Toulouse, 14–16 May 1997.

“A Computable Policy Model of Eastern European Agriculture and the Food Industry” (with Janda, Goodhue, Lyons, and Simon). Prague Economic Papers, 1, 1996.

“Trade Analyses and Policy Design (TAPD) Activity to Support Agriculture and Agribusiness Projects in Central and Eastern European Countries.” Project report, Department of Agricultural and Resource Economics, University of California, Berkeley; coordinated by the Institute of Policy Reform (Grant No. M2055, Fund No. 79048) and funded by the U.S. Agency for International Development (Agreement PDC-0095-A-00-1126-00).

“Animal Agriculture’s Impact on Water Quality in California.” Panel discussion at a conference sponsored by the University of California Animal Agriculture Research Center, Agricultural Issues Center, and the Division of Agriculture and Natural Resources. Sacramento, CA, October 20, 1994.

“Multidisciplinary Problem-Solving and Issue-Oriented Work with the PC/TC Approach.” Prepared for the multidisciplinary workshop, “Strategies and Agendas for the Rural Social Sciences,” the Social Science Agricultural Agenda Project sponsored by The American Agricultural Economics Association, the Rural Sociological Society, the Agricultural History Society, and others, Kansas City, MO, August 1–4, 1991.

“International Policy Reform: Opportunities and Obstacles.” Prepared for Plenary Presentation at the Summer 1991 Meeting of the Business-Higher Education Forum, University of California, Santa Barbara, June 27–29, 1991.

“Futures Market Performance and Behavior.” Report prepared for the Managed Futures Symposium, New York, May 1–3, 1991.

“Urban Labor Markets and Economic Policy/Institutional Reform: Summary of a Workshop” (one of many collaborators). Development Discussion Paper No. 329 (Economic Policy Series). Cambridge: Harvard Institute for International Development, April 1990.

“Professional Relationships and the Role of Increasing Sophistication: Agricultural Economics and Economics” (with Richard E. Just). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, August 1989.

“United States Pledging Statement.” Report to the 32nd Meeting of the Intergovernmental Group on Indonesia. The Hague, Netherlands, June 1989.

“The Structure of the Intergovernmental Group on Indonesia.” The Hague, Netherlands. Unpublished report to the 32nd Meeting of the Intergovernmental Group on Indonesia, June 1989.

“A New Approach to Country Development Strategy Statements.” Report to the Administrator, Agency for International Development, May 1989.

“Privatization and the Provision of Social Services.” Confidential report to the Administrator, Agency for International Development, April 1989.

“The Thailand Mission and Economic Analytical Support.” Confidential Report to the Administrator, Agency for International Development, March 1989.

“The Philippines Mission and Economic Analytical Support.” Confidential Report to the Administrator, Agency for International Development, March 1989.

“The Pakistan Mission and Economic Analytical Support.” Confidential Report to the Administrator, Agency for International Development, March 1989.

“Major Economic Constraints, Challenges and Objectives of the U.S. Foreign Assistance Program.” Position paper to the Administrator, Agency for International Development. Unpublished, March 1989.

"The Indonesia Mission and Economic Analytical Support." Confidential Report to the Administrator, Agency for International Development, March 1989.

"The Bangladesh Mission and Economic Analytical Support." Confidential Report to the Administrator, Agency for International Development, March 1989.

"The Afghanistan Mission and Economic Analytical Support." Confidential Report to the Administrator, Agency for International Development, March 1989.

"Third World Debt and A.I.D.'s Position." Confidential Report to the Administrator, Agency for International Development, January 1989.

"An Institute for Policy Reform." Position paper to the Administrator, Agency for International Development. Unpublished, January 1989.

"An Economic Development Consortium." Position paper to the Administrator, Agency for International Development. Unpublished, January 1989.

"An A.I.D. Economic Research Associate and Fellowship Program." Position paper to the Administrator, Agency for International Development. Unpublished, January 1989.

"Toward a Framework for the Design of Internal Agricultural Policy Reform." Report presented to the Economic Research Service, U.S. Department of Agriculture, 1988.

"The Honduras Mission and Economic Analytical Support." Confidential Report to the Administrator, Agency for International Development, November 1988.

"The Guatemala Mission and Economic Analytical Support." Confidential Report to the Administrator, Agency for International Development, November 1988.

"Government Credibility, Partial Compensation, and the Market for Policy Reform." Report to the International Agricultural Trade Consortium, August 1988.

"The El Salvador Mission and Economic Analytical Support." Confidential Report to the Administrator, Agency for International Development, November 1988.

"The Costa Rica Mission and Economic Analytical Support." Confidential Report to the Administrator, Agency for International Development, November 1988.

"Determination of the Predominance of Various Expectation Patterns in Commodity Future and Spot Markets" (with Richard E. Just). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley 1988.

"Restructuring the Farm Credit System" (with Susan Woodward). Confidential Report to the Farm Credit Administration, Washington, DC, 1987.

“The Effects of U.S. Macro and Micro Policies on LDC Debtors: Measuring Commodity Price Linkages” (with Marjorie Rose). Report presented to the International Monetary Fund. Washington, DC, 1987.

“The Environmental Effects of U.S. Agriculture and Food Policies: The Case of Water Quality and Quantity.” Confidential Report presented to the Environmental Protection Agency, Washington, DC, 1987.

“The Design and Implementation of Public Policy Reform.” Report to the Agency for International Development, Washington, DC, 1987.

“Political Failure and the Reform of Agricultural Policy.” Paper presented to the Australian Society of Agricultural Economics, Adelaide, Australia, February 1987.

“Necessary and Sufficient Conditions for Policy Reform.” Report to the Agency for International Development, Washington, DC, 1987.

“GATT Negotiations and Agriculture: Alternative Measures of Government Intervention.” Confidential Report presented to the U.S. Trade Representative, Washington, DC, 1987.

“Agriculture Research: The Incidence of Burden in the Public and Private Sector.” Confidential Report to the Agriculture Research Service, U.S. Department of Agriculture, 1987.

“Political Failure and the Design of U.S. Agricultural Policy.” In *The Science of Agriculture and Natural Resources—A Foundation for the Future*. Berkeley: Division of Agricultural and Natural Resources, University of California, 1986.

“Sources of Misery in California and U.S. Agriculture.” Report presented to the California League of Women Voters, Los Angeles, CA, 1986.

“Effects of Dollar Value Changes.” Report to the Conference on Pacific Rim: Issues and Opportunities. California Agricultural Trade Seminars, 1986.

“Political Failure and the Design of U.S. Agricultural Policy.” *Town Hall California Reporter*, March/April, 1987, pp. 3–4.

“Multiple Effects of Exchange Rates on Import Demand: The Case of U.S. Agricultural Trade with Japan” (with Yasuo Nishiyama). University Of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, 1986.

“Information, Risk Allocation, Transaction, and Linkage Efficiencies in Futures Markets” (with William E. Foster, Dermot Hayes, and Nicholas Walraven). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, 1986.

“Lead-Lag Price Relationships Among Commodity Futures Markets” (with Colin A. Carter). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, 1985.

“Real Income Stabilization and Food Security for LDC’s” (with Kathryn M. Gordon). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, 1984.

“The Efficiency and Equity Implications of Policy Alternatives in Agricultural Systems of LDCs” (with Richard E. Just and David Zilberman). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, 1982.

“Post-Bayesian Statistical Inference” (with Arnold Faden). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, 1982.

“An Optimal Dynamic Hedging Model for Grains” (with Ray Nelson and Andrew Schmitz). University of California, Department of Agricultural and Resource Economics. Unpublished manuscript, Berkeley, 1981.

“Construction of Decision Support Systems for Agricultural Marketing Boards and Other Public Agencies in Less Developed Countries: Part I” (with Joseph Yassour). AID Contract No. AID/DSAN-C-0001, Washington, DC, 1979.

“Construction of Decision Support System for the National Grains Authority of the Philippines: Part II” (with Joseph Yassour). AID Contract No. AID/DSAN-C 0001, Washington, DC, 1979.

“Development of Iowa Coal: A Systems Analytical Approach” (with R. Levins and A. Pagoulatos). Iowa State University, Energy and Mineral Resources Research Institute Report No. IS-ICP-9, Ames, IA, 1975.

“The Feasibility of Mining Coal in Iowa: An Economic Evaluation” (with R. A. Levins and M. D. Boehlje). Iowa State University, Energy and Mineral Resources Research Institute Report No. IS-ICP-6, Ames, IA, 1975.

“The Commonwealth Edison System” (with G. Fishelson). University of Chicago, Urban Economics Report, Chicago, 1975.

“Environmental Impacts of an Electrical Energy Systems Growth” (with G. Fishelson). University of Chicago, Urban Economics Report, Chicago, 1975.

“Environmental Effects of Altering the Existing Commonwealth Edison System” (with G. Fishelson). University of Chicago, Urban Economics Report, Chicago, 1975.

“Taxes as Solutions to Externalities” (with R. Zerbe). University of Chicago, Urban Economics Report, Chicago, 1974.

“Enforcement, Transaction Costs, and Monitoring of Pollution” (with G. Fishelson). University of Chicago, Urban Economic Report, Chicago, 1974.

“Approximate Adaptive Control Solutions to the U.S. Beef Trade Policy Problem.” (with J. W. Freebairn). University of Chicago, Center for Mathematical Studies in Business and Economics, Report No. 7337, Chicago, 1973.

“Learning, Production, and Investment in Natural Resource Industries.” University of Chicago, Center for Mathematical Studies in Business and Economics, Report No. 7336, Chicago, 1973.

“A Dynamic Econometric Model of the California-Arizona Orange Industry.” Unpublished Ph.D. dissertation, University of California, Davis, 1971.

Working Papers

"Managing R&D Risk in Renewable Energy" (with Maya Papineau) Department of Agricultural & Resource Economics, UCB. CUDARE Working Paper 1058. June 2008.

“Unintended Consequences: The Spillover Effects of Common Property Regulations” (with Marty Kovach, Ryan Stifter and Stephen Hamilton). Department of Agricultural and Resource Economics Working Paper No. 1053, University of California, Berkeley, March 2008

“Pollution and Land Use: Optimum and Decentralization” (with Richard Arnott and Oded Hochman), Department of Agricultural and Resource Economics Working Paper No. 1054, University of California, Berkeley, March 2008.

“The Political Economy of Groundwater Management in California” (with Susan E. Stratton).

“Domestic Support Disciplines in the WTO” (with H.D. Gorter, Q. Luong, and L.K. Simon).

“Incentives and tradeoffs for politicians in the policy setting process” (with Ricardo H. Cavazos-Cepeda) submitted to 2007 MPSA Conference.

“Option Values and Externalities from Public/Private Interaction in Agricultural Research” (with Jason A. Winfree and Jill J. McCluskey). Presented at the 2005 Annual Meeting of American Agricultural Economics Association (AAEA), August 2005.

“Law in Vertical Market Structures: The Role of Benefit-Cost Analysis” (with Richard E. Just).

“Causes of Multifunctionality: Pollution or Politics?” (with Kathy Baylis, Stephen Peplow and Leo Simon). Food and Resource Economics Working Paper, 2005-01. University of British Columbia. <http://agecon.lib.umn.edu/cgi-bin/pubview.pl?pubid=78>

Agri-Environmental Programs in the United States and the European Union (with Kathy Baylis, Stephen Peplow and Leo Simon). Food and Resource Economics Working Paper, 2004-06. University of British Columbia.

“Does Community Involvement Matter? How Collective Choice Affects Forests in Mexico” (with Camille Antinori). Department of Agricultural and Resource Economics Working Paper

No. 939, University of California, Berkeley, January 2003.

http://repositories.cdlib.org/are_ucb/939/

"The Social Costs of an MTBE Ban in California" (with Gregory D. Adams, W. David Montgomery and Anne E. Smith). Department of Agricultural and Resource Economics Working Paper No. 932. University of California, Berkeley, June 2002.

"The Social Costs of an MTBE Ban in California (Condensed Version)" (with Gregory D. Adams, W. David Montgomery and Anne E. Smith). Department of Agricultural and Resource Economics Working Paper No. 931. University of California, Berkeley, June 2002.

"Complementarities and spill-overs in agricultural biotechnology mergers" (with Alan C. Marco). Department of Agricultural and Resource Economics Working Paper No. 930. University of California, Berkeley, June 2002.

"Fitting the Glass Slipper: Optimal Capital Structure in the Face of Liability" (with Klaas T. van 't Veld and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 917. University of California, Berkeley, October 2000.

"Vertical Integration in Mexican Community Forestry" (with Camille M. Antinori). Department of Agricultural and Resource Economics Working Paper No. 915. University of California, Berkeley, October 2000.

"Environmental Remedies: An Incomplete Aggregation Game" (with Leo K. Simon and Jinhua Zhao). Berkeley Program in Law & Economics, Working Paper Series, Year 2000, Paper 21. <http://repositories.cdlib.org/blewp/21/>

"Valuing Research Leads: Bioprospecting and the Conservation of Genetic Resources" (with Arthur A. Small). Berkeley Program in Law & Economics, Working Paper Series, Year 2000, Paper 20. <http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1022&context=blewp>

"A Matlab Version of the Multilateral Bargaining Model Applied to the Ardour Case Study" (with R. Goodhue, S. Morardet, P. Rio, L. Simon and S. Thoyer). Working Paper, Cemegraf, Montpellier, France.

"Les Formes Institutionnelles de la Gestion de l'Eau en France et en Californie: Droits de propriété, decentralization et delegation" (with R. Goodhue, S. Morardet, P. Rio, L. Simon and S. Thoyer). Department of Agricultural and Resource Economics Working Paper. University of California, Berkeley, 1999.

"Intellectual Property and Market Structure in Agriculture" (with Leo K. Simon and Suzanne Scotchmer). Department of Agricultural and Resource Economics Working Paper No. 880, University of California, Berkeley, April 1999.

"Bioprospecting with Patent Races" (with Arthur Small). Department of Agricultural and Resource Economics Working Paper No. 878, University of California, Berkeley, 1999.

“The Basis for Political Preference Functions and Implications for Use” (with Jill J. McCluskey). Department of Agricultural and Resource Economics Working Paper No. 876, University of California, Berkeley, 1999.

“Zoning as a Control of Pollution in a Spatial Environment” (with Oded Hochman). Department of Agricultural and Resource Economics Working Paper No. 875, University of California, Berkeley, January 1999.

“A Dynamic Model of the Food Processing Sector in the New Market Economies of Central Europe” (with Rachael E. Goodhue, Robert Lyons, and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 859, University of California, Berkeley, May 1998.

“Processor Placements and Producer Incentives: Analyzing Broiler Chicken Production Contracts” (with Rachael E. Goodhue and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 858 rev., University of California, Berkeley, February 2000.

“Cleanup Delays at Hazardous Waste Sites: An Incomplete Information Game” (with Leo K. Simon and Jinhua Zhao). Department of Agricultural and Resource Management Working Paper No. 839, University of California, Berkeley, April 1999.

“A Computable Model of Eastern European Food Processing” (with Rachael E. Goodhue, Robert Lyons, and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 838, University of California, Berkeley.

“Product Quality and Off-Farm Control: Fresh and Processed Tomatoes” (with Rachael E. Goodhue). Department of Agricultural and Resource Economics Working Paper, University of California, Berkeley.

“A Bayesian Model of Market Learning” (with Rachael E. Goodhue and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 837, University of California, Berkeley.

“Public and Private Provision of Public and Private Goods: A Bargaining-Theoretic Perspective” (with Leo K. Simon). Department of Agricultural and Resource Management Working Paper No. 836, University of California, Berkeley, March 1998.

“The Market for Genetic Resources: Prior Information and Conservation Incentives.” Working Paper No. 831. Department of Agricultural and Resource Economics, University of California, Berkeley, 1998.

“Environmental Activism and the Public Interest (with Jill J. McCluskey). Department of Agricultural and Resource Economics Working Paper No. 802, University of California, Berkeley.

“Intellectual Property Rights and Market Structure in Agricultural Biotechnology” (with Arthur Small and Seung Jick Yoo). Department of Agricultural and Resource Economics Working Paper No. 799, University of California, Berkeley.

“Bioprospecting with Prior Ecological Information” (with Arthur Small). Giannini Foundation Working Paper No. 819, 1997.

“The Economic Value of Patents, Licenses, and Plant Variety Protection” (with Arthur A. Small). Department of Agricultural and Resource Economics Working Paper No. 797, University of California, Berkeley, June 1996. http://repositories.cdlib.org/are_ucb/797

“The Analytical Framework for the TAPD Project” (with Rachael E. Goodhue, Robert Lyons and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 762, University of California, Berkeley.

“Political Preference Functions and Political Economic Modelling” (with Leo K. Simon and Klaas van ’t Veld). Department of Agricultural and Resource Economics Working Paper No. 743, University of California, Berkeley.

“Inequality and the Choice of Redistributive and Public Good Policies: The Case of Agriculture” (with Harry de Gorter and Johan F.M. Swinnen). Department of Agricultural and Resource Economics Working Paper No. 742, University of California, Berkeley.

“Independence of Irrelevant Alternatives and Political Economy: A Critique and an Alternative” (with Leo K. Simon and Klaas T. van ’t Veld). Department of Agricultural and Resource Economics Working Paper No. 720, University of California, Berkeley.

“The Economics of Remediation: The Decision Problem Facing a Single PRP” (with Leo K. Simon and Jinhua Zhao). Department of Agricultural and Resource Economics Working Paper No. 711, University of California, Berkeley.

“The Political Economy of Transition: A Bargaining Theoretic Approach” (with Robert F. Lyons and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 709, University of California, Berkeley.

“Instrument Selection in a Bargaining Model of Agricultural and Environmental Policy Reform” (with Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 708, University of California, Berkeley.

“Putty-Clay Politics in Transition Economies” (with Robert F. Lyons and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 707, University of California, Berkeley, May 1996.

“Multilateral Bargaining in a Spatial Environment: Preliminary Results” (with Glenn W. Harrison, Ron Harstad, and Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 670, University of California, Berkeley.

“Transition to a Market Economy: The Case of Russia.” Department of Agricultural and Resource Economics Working Paper No. 666, University of California, Berkeley.

“A Strategic Model of Environmental Dispute Resolution” (with Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 662, University of California, Berkeley.

“The Political Economy of Productive and Predatory Policies: The Case of U.S. Dairy Policy” (with Harry de Gorter and David Nielson). Department of Agricultural and Resource Economics Working Paper No. 661, University of California, Berkeley.

“Academic Research in Future Markets Performance and Behavior.” Department of Agricultural and Resource Economics Working Paper No. 656, University of California, Berkeley.

“International Policy Reform: Opportunities and Obstacles.” Department of Agricultural and Resource Economics Working Paper No. 653, University of California, Berkeley.

“Commodity Versus Research Policies under Endogenous Political Weights” (with Harry de Gorter and Jo Swinnen). Department of Agricultural and Resource Economics Working Paper No. 649, University of California, Berkeley.

“A Framework for Analyzing Specific Agricultural Policy Reform” (with Richard E. Just and David Zilberman). Department of Agricultural and Resource Economics Working Paper No. 647, University of California, Berkeley, April 1993.

“Burden Sharing and Public Good Investments in Policy Reform: A Numerical Sensitivity Analysis” (with Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 637, University of California, Berkeley, February 1991.

“Burden Sharing and Public Good Investments in Policy Reform” (with Leo K. Simon). Department of Agricultural and Resource Economics Working Paper No. 635, University of California, Berkeley, September 1992.

“Interactions Among Money, Exchange Rates, and Commodity Prices” (with Pier Giorgio Ardeni). Department of Agricultural and Resource Economics Working Paper No. 621, University of California, Berkeley, March 1992.

“A Noncooperative Model of Collective Decision Making: A Multilateral Bargaining Approach” (with Leo Simon). Department of Agricultural and Resource Economics Working Paper No. 620, University of California, Berkeley.

“Food Security, Land Allocation, and Country Hedging: A Case Study of China” (with Jianmin Liu). Department of Agricultural and Resource Economics Working Paper No. 594, University of California, Berkeley.

“Policy Preference Functions: Grand Themes and New Directions” (with H. Alan Love and Diana M. Burton). Department of Agricultural and Resource Economics Working Paper No. 571, University of California, Berkeley, May 1990.

“Coupling Wealth Transfer Under Uncertain Rates of Technical Change (with William E. Foster). Department of Agricultural and Resource Economics Working Paper No. 542, University of California, Berkeley, August 1990.

“LDC Debt and Policy Linkages in the Determination of World Commodity Prices” (with Coleman Bazelon). Department of Agricultural and Resource Economics Working Paper No. 538, University of California, Berkeley, June 1990.

“Endogenous Policy Theory: The Political Structure and Policy Formation” (with Pinhas Zusman). Working Paper No. 537. Department of Agricultural and Resource Economics, University of California, Berkeley, 1990.

“The Role of Institutions and Policy Reform in U.S. Foreign Assistance.” Working Paper No. 522, Department of Agricultural and Resource Economics, University of California, Berkeley, 1990.

“Endogenizing U. S. Milk Price Supports” (with Harry de Gorter). Department of Agricultural and Resource Management Working Paper No. 504, University of California, Berkeley, 1989.

“Flexible Public Policy: The Case of the United States Wheat Sector” (with H. Alan Love). Department of Agricultural and Resource Management Working Paper No. 494, University of California, Berkeley, 1988.

“Agricultural Policy in Economies with Uncertainty and Incomplete Markets” (with Robert D. Innes). Department of Agricultural and Resource Economics Working Paper No. 457, University of California, Berkeley, 1987.

“Monetary Policy and Relative Farm Prices” (with James A. Chalfant and Kostas G. Stamoulis). Department of Agricultural and Resource Economics Working Paper No. 413, University of California, Berkeley.

“Futures Market and Efficiency” (with Nicholas A. Walraven). Department of Agricultural and Resource Economics Working Paper No. 411, University of California, Berkeley, 1986.

“Macroeconomics, Overshooting, and the U.S. Agriculture Sector” (with Yasuo Nishiyama and Kostas G. Stamoulis). Department of Agricultural and Resource Economics Working Paper No. 410, University of California, Berkeley, 1986.

“The Effects of Monetary Policy on U.S. Agriculture” (with James A. Chalfant, H. Alan Love, and Kostas G. Stamoulis). Department of Agricultural and Resource Economics Working Paper No. 409, University of California, Berkeley, 1986.

“Exchange Rates: Backward Linkage on U.S. Agriculture—The Case of Japan” (with Yasuo Nishiyama). Department of Agricultural and Resource Economics Working Paper No. 389, University of California, Berkeley, 1985.

“Monetary Policies and the Overshooting of Flexible Prices: Implications for Agricultural Policy” (with James A. Chalfant and Kostas G. Stamoulis). Department of Agricultural and Resource Economics Working Paper No. 372, University of California, Berkeley, 1985.

“Farm Capital Structure and the Agency Cost of Outside Equity Ownership” (with Kathryn M. Gordon). Department of Agricultural and Resource Economics, University of California, Berkeley, 1990.

CASE STUDIES

Harvard University, Graduate School of Business Administration
Spring, 1978

Biogas of Colorado.

Biotechnology and Agribusiness.

Costs and Benefits of Models and Their Use in the Food Sector.

Crown Zellerbach and the Management of Natural Resources.

DRI Commodity Management Consultants.

Effective Management and Utilization of Information Systems.

Food Conglomerate, Inc.

MacIntosh Chocolate Company (a).

MacIntosh Chocolate Company (b).

MacIntosh Chocolate Company (c).

MacIntosh Chocolate Company (d).

Manual for Designing, Constructing, and Using a Decision Support System.

Note on Agricultural Sector Forecasts and Policy Evaluations.

Note on Market Risk in Agribusiness.

Note on Strategic Policy Evaluations.

The Philippines National Rice and Grain Authority

Tariff and Nontariff Trade Barriers

The World Bank and Agriculture in Less Developed Countries.

Spring, 1977

Agricultural Chemical International.

Contractual Relationships in the Turkey Industry.

Contractual Relationships in the Beet Sugar Industry.

Fed-Rite Food Distribution.

Forecasting in the Food Freezing Sector.

High Fructose Corn Syrup Manufacturing (a).

High Fructose Corn Syrup Manufacturing (b).

Note on Risk Management Frameworks.

Proposals for Grain Reserves.

Spreckels Sugar Division (a).
Spreckels Sugar Division (b).
U.S. Feed Grain Reserve Policy.

Fall, 1976

Choosing Among Risk Profiles.
Importance of a Good Forecasting System.

Spring, 1976

Chase Econometric Associates, Inc.
Chemical Bank (a).
Chemical Bank (b).
Common Commodity Future Market Fund.
Data Resources, Inc.
Design and Implementation of Decision Models.
Florida Department of Citrus.
Food Grain Import Policies in Bangladesh (a).
Food Grain Import Policies in Bangladesh (b).
Hedging and Pure Speculation.
Israel Poultry Marketing Board.
Rancho Matilija.
Statistical Decision Theory Frameworks.
Thomte and Company.

Spring, 1974

Simulation Models in Agribusiness.
Survey and Use of Decision Support Systems.

SELECTED KEYNOTE OR PLENARY SESSION PRESENTATIONS

“Managing R&D Risk in Renewable Energy” (with Maya Papineau) Presented at *Risk, Infrastructure, and Industry Evolution* conference, June 2008.

“Commodity Price Boom: Implications for California Agriculture, Resources and Environment”, Presented at President’s Advisory Commission on Agriculture and Natural Resources, April 2008.

“Agricultural Biotechnology in California and the EU”, Presented at EU-California Regulatory Cooperation Project Workshop, February 2008.

“Collective Choice: A Multilateral Bargaining Approach” Presented at Beijing University, May 2007.

“Property rights and collective action in natural resources with application to Mexico”, presented June 2007, Casa de California, Mexico City.

“Second Stage: Political Economy Analysis of Distortion Patterns” Presented at Political Economy of Distortions to Agricultural Incentives conference, July 2007.

“Political Economy of Distortion Patterns Across Time and Countries.” Presented at The World Bank Conference on Distortions to Agricultural Incentives in Developing Countries, Bellagio Center, Bellagio, Italy, November 2006.

“General Equilibrium in Vertical Market Structures: Monopoly, Monopsony, Predatory Behavior and the Law.” (with Richard E. Just) Benefit-Cost Analysis Conference, University of Washington, Seattle, Washington May 18-19, 2006.

“The Giannini Foundation and the Welfare of California Agriculturalists in a Changing State, Nation, and World.” The Giannini Foundation of Agricultural Economics 75th Anniversary Symposium, UC Davis, California, May 3, 2006.

“Money and Control: Generating Transfer Water in California’s Imperial Valley” (with Leo Simon and Susan Stratton). Conference of the International Association of Agricultural Economists, Queensland, Australia, 12-18 August, 2006.

“Complementarities across Quality Incentive Instruments” (with Rachael Goodhue). Annual Meeting of the Allied Social Science Associations, Boston, Massachusetts, January 6-8, 2006.

“Option Values and Externalities from Public/Private Interaction in Agricultural Research” (Jason A. Winfree and Jill J. McCluskey). Presented at the Annual Meeting of American Agricultural Economics Association (AAEA), August 2005.

“Causes of Multifunctionality: Externalities or Political Pressure?” (with Kathy Baylis, Stephen Peplow and Leo Simon) Annual Meetings of the Western Agricultural Economics Association, San Francisco, California, July 6-8, 2005.

Nutrition, Food, Policies, and Obesity, American Agricultural Economics Association Annual Meeting, invited principal paper presentation, Providence, Rhode Island, July 24–27, 2005.

“Governance Structures and Multilateral Bargaining in Natural Resource Systems,” Toulouse Roundtable on Economic Policy-tribute to Jean Jacques Laffont, June 30–July 2005, Toulouse, France

“The political economy of agri-environmental policies in the U.S. and the EU,” Institute of European Studies Center for Governance and Institutions, University of California, Berkeley, May 27–28, 2005.

“Are Environmental Toxins a Source of Health Shocks to Children? Evidence from Hispanic Children in the U.S.” (with Bo MacInnis). Presentation at the 2005 Annual Meeting of American Economic Association, Philadelphia, Pennsylvania, January 7–9, 2005.

"Property Rights and Water Transfers: Bargaining Among Multiple Stakeholders" with Leo K. Simon and Susan E. Stratton. Selected for presentation at the Center for Sustainability, Environment, Equity and Partnership's International Conference on "Security and Sustainability in Water Resources" in Kathmandu, Nepal, September 6-9, 2004.

“Transaction Costs and Organic Marketing: Evidence from U.S. Organic Produce Farmers” (with Bo MacInnis). Presented at the 2004 Annual Meeting of American Agricultural Economics Association (AAEA), Denver, Colorado, August 1–4, 2004.

“Vulnerable Children: The Case of Pesticide Exposure and Hispanic Children” (with Bo MacInnis). Presented at the 2004 Annual Meeting of American Agricultural Economics Association (AAEA), Denver, Colorado, August 1–4, 2004.

Structure and Power in Multilateral Negotiations: An Application to French Water Policy, Society for Economic Design 2004 (SED 2004), Universitat de les Illes Balears, Palma de Mallorca, Spain, June 29–July 3, 2004.

Price-Location Games when Consumers Have Heterogeneous Tastes,” with Leo K. Simon. Presented at the 6th INRA-IDEI (Institut National de la Recherche Agronomique-Institut d’Economie Industrielle) Conference “Industrial Organization and the Food Processing Industry,” June 4–5, 2004 in Toulouse, France.

Stan Johnson: A Giant Among Mentors, Opening invited address, Exploring Frontiers in Applied Economics, A Symposium in Honor of Stanley R. Johnson, Iowa State University, Ames, IA, October 24–25, 2003. Published electronically in Essays in Honor of Stanley R. Johnson: <http://www.bepress.com/sjohnson/art5>.

John Kenneth Galbraith: The Early Years, (with Susan Stratton), First Galbraith Forum/Lecture of the Galbraith Commemorative Project, 2003 Annual Meeting AAEA Foundation, Keynote Speaker for Tribute to John Kenneth Galbraith, Montreal, Quebec, July 28–30, 2003.

Agri-environmental Programs and the Future of the WTO (with Leo Simon and Kathy Baylis), Capri, Italy, June 24–26, 2003.

Canada-U.S. Agricultural Policy and the WTO, Keynote Speaker, Conference of the Canadian Studies Program, International and Area Studies Institute, University of California, Berkeley, CA, May 9, 2003.

Incomplete Aggregation Games (with Leo Simon), Department of Agricultural and Resource Economics Seminar, University of California, Berkeley, CA, May 9, 2003.

“Potential Financial Innovations in the Development of Biodiversity and Renewable Resources,” presentation at the Milken Institute, April 2003.

Public-Private Research Agreements: Where Does the Control Reside? Distinguished Speaker Seminar, Michigan State University, Lansing, MI, November 14, 2002.

Complementarities and Spill-overs in Mergers: An Empirical Investigation Using Patent Data (with Alan Marco). Eleventh Annual WZB Conference on Industrial Organization, Innovation Policy in International Markets, Social Science Research Center Berlin WWZB) and the Centre for Economic Policy Research (CEPR), Berlin, October 2002.

Structure and Power in Multilateral Negotiations: An Application to French Water Policy, (with Leo Simon, Rachael Goodhue and Sylvie Morardet). Second World Congress of Environmental and Resource Economists, Monterey, CA, June 2002.

Genetic Resource Libraries: Bioprospecting and Knowledge Assets, (with Arthur Small). Second World Congress of Environmental and Resource Economists, Monterey, CA, June 2002.

Ecological Effects of Timber Contracting in Mexico's Community Forestry Organizations, (with Camille Antinori). Second World Congress of Environmental and Resource Economists, Monterey, CA, June 2002.

Financial Contracts Embedded in R&D Agreements. Natural Resource Management, Growth and Political Economy: A symposium in honor of Professor Eithan Hochman, Hebrew University, Rehovot, Israel, June 3, 2002.

A Financial Contracting Approach to Public/Private Relationships. Tweeten Seminar, Ohio State University, May 30, 2002. Public/Private Research Agreements. CSHE 2001–2002 Grant Recipients Colloquium, Berkeley, CA, May 10, 2002.

Public-Private Relationships in Horticulture R&D. Workshop on Biotechnology for Horticultural Crops, Monterey, CA, March 7–9, 2002. Structuring Public/Private Research Agreements. Conacyt Workshop on University-Industry Collaboration, University of California, Berkeley, December 4, 2001.

Structuring Public/Private Research Agreements. Beahrs Environmental Leadership Program, Workshop 6: "Innovation, Technology, and Entrepreneurship," Berkeley, CA, July 23, 2001.

Genetic Resource Libraries: Bioprospecting and Knowledge Assets (with Arthur Small). NCEAS Workshop on Economics of Biodiversity, Santa Barbara, CA, May 2001.

Conceptual Foundations of Expectations and Implications for Estimation of Risk Behavior (with Richard Just). Annual Meetings of Regional Project SERA-IEG 31: Economics and Management of Risk in Agriculture and Natural Resources, Gulf Shores, AL, March 22–24, 2001.

Incentives for Innovation. NC208 Conference: R&D Policies and Impact Assessment, Berkeley, CA, March 30–31, 2001.

Public Universities and Agricultural Biotechnology, American Association for the Advancement of Science Annual Meeting and Science Innovation Exhibition, Session on the Public Sector's Role in Agricultural Biotechnology, San Francisco, CA, February 18, 2001.

Structuring Public/Private Research Agreements. 2001 Agriculture Program Conference, Texas A&M University, College Station, TX, January 10, 2001.

Mergers and Intellectual Property in Agricultural Biotechnology, (with Alan Marco). ICABR Fourth International Conference on the Economics of Agricultural Biotechnology, Ravello, Italy, August 24–28, 2000.

Biotechnology R&D in Developing Countries: Negotiating Public-Private Research Partnerships, (with Leo Simon and Holly Ameden). Fourth International Conference on the Economics of Agricultural Biotechnology, Ravello, Italy, August 24–28, 2000.

Second-Phase Reform Measures in Latin America. Meeting of the Boards of Governors IDB/IIC at the Conference: Development of the Rural Economy and Poverty Reduction in Latin America and the Caribbean, New Orleans, LA, March 24, 2000.

Knowledge Gaps, Private/Public Alliances. Fontagro Research Design Conference, Texas A&M University, College Station, TX, November 11, 1999.

Knowledge Gaps, Private/Public Alliances: Interfaces Seminar, Columbia University, New York, NY, November 10, 1999.

Negotiating Public/Private R&D Alliances. Assessing the Impact of Agricultural Research on Poverty Alleviation. GIAT Conference, San José, Costa Rica, September 16, 1999.

What Future for Agriculture as a Knowledge Based Industry. USDA, ERS, Washington, DC, August 12, 1999.

Do Incentives Matter? Product Quality and Contract Incentives in Processing Tomatoes. Presented to AAEA Conference, Nashville TN, August 11, 1999.

Public and Private Research: Knowledge Assets and Future Scenarios. Fellows Keynote Address. AAEA Conference, Nashville TN, August 10, 1999.

Intellectual Property and Market Structure in the Biotechnology Industry. AAEA Conference, Nashville TN, August 8–11, 1999.

Intellectual Property and Market Structure in Agriculture. National Bureau of Economic Research Summer Institute, July 19, 1999.

Intellectual Property, Complementarities and Competition: Assessing Organizational Changes in Agbiotech. Transitions in Agbiotech Conference, Washington DC, June 24–25, 1999.

Intellectual Property and Market Structure in Agriculture. Conference on “The Shape of Coming Agricultural Biotechnology Transformation: Strategic Investment and Policy Approaches from an Economic Perspective,” Rome, Italy, June 17, 1999.

Agricultural Biotechnology’s Complementary Intellectual Assets. Conference on “The Shape of Coming Agricultural Biotechnology Transformation: Strategic Investment and Policy Approaches from an Economic Perspective,” Rome, Italy, June 17, 1999.

Opening Session Remarks. Wildlife Management Institute, 64th North American Wildlife and Natural Resources Conference. Burlingame, CA, March 29, 1999.

Intellectual Property and Market Structure in Agriculture. R&D Investment and Economic Growth in the 20th Century Conference, Berkeley, CA, March 27, 1999.

The New Rent Seeking: Implications for International Trade. Agricultural Globalization, Trade and the Environment Conference. Berkeley, CA, March 8–9, 1999.

Alignment of Public/Private Institutions in the Biotechnology Revolution. USDA Agricultural Outlook Forum, Washington DC, February 22–23, 1999.

What will the Impact of Intellectual Property Issues be on the Practice of Agriculture in the Future of California. DANR Statewide Conference, Sacramento, CA, February 2, 1999.

The Market for Genetic Resource Conservation. Association of Environmental and Resource Economists Papers Sessions at the Allied Social Science Associations 1999 Annual Meeting. New York, NY, January 4, 1999.

Intellectual Property and Alignment of Public and Private Incentives. “Biotechnology, 1998: From Research Pipeline to Marketplace.” Heidrick Museum, Woodland, CA, November 11, 1998.

Collective Choice in Water Resource Systems. “Workshop on the Political Economy of Water Pricing Implementation.” The World Bank, Washington DC, November 3–5, 1998.

Deriving Biodiversity Option Value within a Model of Biotechnology Research and Development. Conference on “Valuing and Managing Ecosystems: Economic Research.” NSF/EPA, Washington, DC, October 29, 1998.

University/Private Agreements and Public Good Research. University-wide Patent Coordinators Meeting, Soizic Cafe, Oakland, CA, October 15, 1998.

A Bayesian Model of Market Learning. Department of Agricultural and Resource Economics, University of California, Berkeley seminar, May 1998; and at Stonybrook conference on Interactive Dynamics and Learning, July 1998.

Intellectual Property and Alignment of Public and Private Incentives: Crowding In Public Good Research. “Knowledge Generation and Transfer: Implications for Agriculture in the 21st Century.” Faculty Club, University of California, Berkeley, June 18–19, 1998.

American Agricultural Politics. Workshop, Council for Economy Analysis, Paris, France, May 29, 1998.

Water Resource Systems in California and France: Similarities and Differences. University of Montpellier faculty, May 30, 1998.

Valuing Biodiversity. Prepared for “Managing Human-dominated Ecosystems,” Missouri Botanical Garden. St. Louis, MO, March 27, 1998.

What Future for California Agriculture—Where Are We Going? California Citrus Expo, Visalia, CA, March 12, 1998.

What Future for California Agriculture? Chancellor's Agricultural Advisory Council. University of California, Riverside, December 2, 1997.

What Future for Agriculture? California Commodity Committee Annual Meeting. Davis, California, October 29, 1997.

Food Security, Diversification, and Resource Management; Refocusing the Role of Agriculture. International Conference of Agricultural Economists, Sacramento, California, August, 1997.

Value Differentiation. American Agricultural Economics Association, July 1997.

Value Differentiation in Agriculture: Driving Forces and Complementarities. Prepared for "Vertical Relationships and Coordination in the Food System." Universita Cattolica del Sacro Cuore, Piacenza, Italy, June 1997.

Value Differentiation in Agriculture: Driving Forces and Complementarities. "Vertical Relationships and Coordination in the Food System," University of California, Berkeley, June 12–13, 1997.

Value Differentiation and the Broiler Industry. University of Paris, May 13, 1997.

Deriving Biodiversity Option Value within a Model of Biotechnology Research and Development. 1997 Workshop on Valuation and Environmental Policy. NSF/EPA Partnership for Environmental Research. Arlington, Virginia, April 7–8, 1997.

Taking Responsibility for our Environments. 3rd Annual Environmental Partnerships Symposium, "The City and the Environment." University of California, Berkeley, Friday, November 22, 1996.

Incentive Structures for Allocating Public Research Resources. "Global Agricultural Science Policy for the Twenty-First Century." Melbourne, Australia, August 16–18, 1996.

Presented Opening Remarks to Conference, Voices from the Commons, International Association for the Study of Common Property. University of California, Berkeley, June 5, 1996.

A New Perspective on Sustainability: A Framework of Dispute Resolution. Environmental Leadership Roundtable, University of California Extension, San Francisco, California, May 17, 1996.

Cooperatives in Transition: Pros and Cons of Free Enterprise in an Uncertain World. Conference on "Industrial Organization and the Food Processing Industry," IDEI and INRA. Toulouse, France, March 28 & 29, 1996.

Cooperatives in Transition: Pros and Cons of Free Enterprise in an Uncertain World. Conference on "Industrial Organization and the Food Processing Industry," IDEI and INRA. Hong Kong. January 1996.

Institutions, Scientific Technology, and the Future of Agriculture. American Feed Industry Association Key Management Conference. San Diego, California, February 9, 1996.

Institutions, Scientific Technology, and the Future of Agriculture. South Central Regional Academic Conference. Division of Agricultural and Natural Resources, University of California, Salinas, California, February 8, 1996.

U.S. Agricultural Policy in the United States. University of California Discussion. Berkeley, California, September 13, 1995.

A Computable Policy Model of Eastern European Agriculture. IPE-CERGE-EI Conference, "Agriculture and Trade Transition Economies: Policy Design and Implementation." Prague, Czech Republic, July 28 & 29, 1995.

The Future of California's Natural Resources. State of California, Resources Agency. University of California, Davis, California, June 22, 1995.

The Environmental Population Tradeoff. Symposium on "Shaping Agriculture in the 21st Century." Radisson Hotel, Davis, California, June 22, 1995.

The College of Natural Resources and Agriculture. University Committee on Research Policy. University of California, Oakland, California, June 20, 1995.

College of Natural Resources Commencement Ceremony, 1995. Presented to the graduating class of 1995. University of California, Berkeley, California, May 1995.

Modelling Multilateral Bargaining and Negotiation Processes. School of Business, Stanford University. Stanford, California, May 1995.

A Vision for the College of Natural Resources. Nutrition, Education, and Family Development Symposium. University of California, Berkeley, May 17, 1995.

Campus Environmentalism/Earth Day. Environmental Spirit Conference (Earth Day). University of California, Berkeley, April 13, 1995.

Sustainable Agriculture and Pest Control. Faculty and Student Symposium on Sustainable Agriculture and Pest Control. University of California, Berkeley, April 12, 1995.

A New Structure for the College of Natural Resources. UC Berkeley's Council of Deans. University of California, Berkeley, April 4, 1995.

Regulating Multiple Polluters: Deterrence and Liability Allocation. University of Michigan, February 1995.

The College of Natural Resources' Role in Biology. Chancellor's Advisory Council, University of California, Berkeley, January 25, 1995.

The Economic Situation and its Impact on Tomorrow's Business. Protein Technologies International Conference, "Staying Ahead of Competition," a seminar of macro and micro issues affecting the poultry industry. Atlanta, Georgia, January 17, 1995.

International Environmental Regulations. Address at the Institute D'Economie Industrielle. Toulouse, France, November, 1994.

The Future of California Agriculture. Ad Hoc Division of Natural Resources Committee (TICHO). University of California, Oakland, California, January 6, 1995.

Challenges to California Agriculture. Executive Seminar on Agricultural Issues. Sacramento, California, December 13, 1994.

Strategies and Options for Sustaining Animal Agriculture—A Watershed Perspective. Panelist at the Animal Agriculture Impacts on Water Quality in California Conference, Animal Agriculture Research Center and Agricultural Issues Center, University of California at Davis, Sacramento, October 20, 1994.

Valuation of Intellectual Property. Stanford Law School, Stanford University. Stanford, California, October 7, 1994.

Alternative Frameworks for Evaluating Natural Resource Damages. University of California. Los Angeles, California, April 7, 1994.

GATT Agricultural Policy Reform: A United States Perspective. Major address to the Regional Council on "Strategies and Perspectives in Agricultural Policies" at the conference, "Agricultural Markets: Mechanisms, Failures, Regulations." Institute D'Economie Industrielle, Toulouse, France, October 12–13, 1993.

The Political Economy of Agricultural/Environmental Policy Reform. Conference on "Agricultural Markets: Mechanisms, Failures, Regulations." Institute D'Economie Industrielle, Toulouse, France, October 12–13, 1993.

The Political Economy of Technology and Commodity Policy in the U.S. Dairy Industry. Conference on "Agricultural Markets: Mechanisms, Failures, Regulations." Institute D'Economie Industrielle, Toulouse, France, October 12–13, 1993.

Contaminant Dynamics and the Cost of Groundwater Quality Regulations, with Alan Marco, David Sunding and David Zilberman. Annual Meetings of the American Agricultural Economics Association, August 1993.

Political Power Theory: Explanation and Description. Opening invited address, Pinhas Zusman Retirement Conference. Hebrew University, Rehovot, Israel, June 1993.

Endogenous Political Economy. Ben Gurion University. Israel, June 1993.

Alternative Instruments for Pollution Control. Economics Department, Hebrew University. Rehovot, Israel, June 1993.

A Strategic Model of Environmental Dispute Resolution. Workshop on Environmental Economics, Santa Barbara, California, May 7–8, 1993.

Transition to a Market Economy: The Case of Russia. Cal Open House, University of California. Berkeley, California, April 24, 1993.

Transition to a Market Economy: The Case of Russia. Keynote Address to U.S. Fund for Democracy and Development. March 1993.

The Political Economy of the Transition Process: The Role of Alternative Governance Structures. American Agricultural Economics Association Meetings. Anaheim, California, January 5 & 6, 1993.

Environmental and Agricultural Policy Linkage and Reforms in the United States under the GATT. American Agricultural Economics Association Meetings, December 1992.

Recent Advances on Futures Markets Performance and Behavior. Fourth Annual Managed Futures Symposium, “Managed Futures as an Institutional Investment.” Chicago, September 30 through October 2, 1992.

An Emerging Framework for Economic Development: An LDC Perspective. Keynote address at the conference, “Industrial Policy for Agriculture in the Global Economy.” Iowa State University, Ames, September 16–17, 1992.

New Frameworks for Designing Compatible Incentives for Policy Reform. Invited Address to the U.S. Agency for International Development. September 1992.

Internal Versus External Agricultural Policy Reform: GATT Negotiations in the Uruguay Round. Invited paper for the American Political Science Association. Chicago, Illinois, September 1992.

A Noncooperative Model of Collective Decisionmaking: A Multilateral Bargaining Approach. American Political Science Association meetings. Chicago, Illinois, September 1992.

A Collective Choice Model for Conflict Resolution in Water Resource Systems. Conference on “Water Quantity/Quality Disputes and the Resolution.” Washington, DC. May 2 & 3, 1992.

Environmental and Agricultural Policy Linkages and Reforms in the United States Under the GATT. Economics Department. Purdue University, March 1992.

Environmental and Agricultural Policy Linkages and Reforms in the United States Under the GATT. Economics Department. Iowa State University, March 1992.

State-Market-Civil Institutions: The Case of Eastern Europe. Invited address at the conference, "State, Market, and Civil Institutions: New Theories, New Practices, and Their Implications for Rural Development." Cornell University, New York, December 13 and 14, 1991.

Liberties and Economic Growth. Keynote address, World Conference on Economic Development. Raleigh-Durham, North Carolina, November 19–21, 1991.

Multidisciplinary Problem-Solving and Issue-Oriented Work with the PC/TC Approach. Keynote address at the multidisciplinary workshop on "Strategies and Agendas for the Rural Social Sciences" under the auspices of the Social Science Agricultural Agenda Project, and sponsored by The American Agricultural Economics Association, the Rural Sociological Society, the Agricultural History Society, et al. Kansas City, Missouri, August 1–4, 1991.

International Policy Reform: Opportunities and Obstacles. Plenary presentation at the Summer 1991 Meeting of the Business-Higher Education Forum. University of California, Santa Barbara, June 27–29, 1991.

The Political Economy of Transition in Eastern Europe: Packaging Enterprises for Privatization. Institute of International Studies, University of California, Berkeley, May 1991.

Futures Market Performance and Behavior. Keynote address at the Managed Futures Symposium. New York, May 1–3, 1991.

The Political Economy of Transition in Eastern Europe: Packaging Enterprises for Privatization. Simon Fraser University. British Columbia, Canada, April 1991.

The Political Economy of Transition in Eastern Europe: Packaging Enterprises for Privatization. Institute of Policy Reform Conference on Institutions and the Transition to a Market Economy. Prague, Czech Republic, March 1991.

Agricultural Reforms in the USSR: A Scientist's Attitude. Soviet-American Symposium. Moscow, October 1990.

The Political Economy of the European Community's Agricultural Policy. Keynote address to the European Agricultural Economics Association. The Hague, September 1990.

Market Politics and Alternative Transition Paths. Conference on "Rural Reform in Socialist Countries: Dilemmas and Strategies," sponsored by the World Bank and the National Bank of Hungary. Budapest, Hungary, August/September 1990.

The Agency for International Development Paradigm on Policy Reform and Economic Development. Major invited address to the Allied Social Science meetings. Atlanta, Georgia, December 1989.

Agricultural Policy Alternatives for the 1990s. Keynote address to the American Agricultural Law Association. San Francisco, California, November 1989.

A New Paradigm for Economic Development. Keynote address at the Economic Development Consortium. November 1989.

An Assessment of the Agricultural Economics Profession. Major invited address to the American Agricultural Economics Association meetings. Baton Rouge, Louisiana, August 1989.

New Institutional Economics and Public Policy. Major invited address to the Development Studies Program, Institute for International Research. The American University, July 1989.

The Evolution and Coordination of U.S. Commodity and Resource Policies. Keynote address at the CARP Symposium. University of Maryland, College Park, May 1989.

Supporting Coalitions for Policy Reform and Institutional Change. Invited plenary presentation to the Indonesian Economic Association, Thailand Economic Association, Pakistan Economic Association, Bangladesh Economic Association, Egyptian Economic Association. February 1989.

The Market for Public Policy Reform. Invited plenary address to the 33rd Annual Conference of the Australian Agricultural Economics Society. New Zealand, February 1989.

Dynamic Welfare Analysis in Commodity Futures Markets. Major invited address to the International Conference of the Applied Econometrics Association. Washington, DC, October 1988.

Endogenizing Policy in Models of Agricultural Markets. Major invited address presented at the Plenary Session of the International Association of Agricultural Economists. Buenos Aires, Argentina, August 1988. Trade Negotiations, Institutional Changes, and Policy Reform. Major invited address to the International Agricultural Trade Consortium. Washington, DC, August, 1988.

The Macroeconomic Dimension of Agricultural Policy Reform. Major invited address at the World Food Conference. Ames, Iowa, June 1988.

The Design and Implementation of Public Policy Reform. Keynote address at the Conference on Agricultural Economic Policy Reform in Egypt. Cairo, Egypt, July 1987.

Stability Issues in Policy Analysis. Major invited address at the Conference on Agricultural Stability in Farm Programs: Concepts, Evidence, and Implications. North Carolina State University, Raleigh, May 1987.

Alternative U.S. Agricultural Trade Policy. Major address to the Benjamin E. Lippincott Symposium on Policy Coordination in World Agriculture. University of Minnesota, St. Paul, April 1987.

Macroeconomic Linkages in U.S. Agriculture. Keynote address at the First Rod F. Ziemer Symposium. University of Georgia, Athens, March 1987.

Political Failure and the Reform of Agricultural Policy. Keynote address to the Australian Agricultural Economics Society. Adelaide, Australia, February 1987.

Public Policy in U.S. Agriculture. Invited major address to the School of Agriculture, the University of Western Australia. Perth, Australia, February 1987.

The Formulation of Agricultural Policy in the United States: Circa, 1987. Invited plenary address to the Australian Agricultural Economics Society and Bureau of Agricultural Economics. Canberra, Australia, February 1987.

The State of Agricultural Economics. Paper presented at the American Agricultural Economics Association Annual Meeting, Iowa State University, August 1986.

New Developments in Economics. Paper presented at the Conference on Agriculture in Rural Areas Approaching the 21st Century: Challenges for Agricultural Economics, Ames, IA, August 1986.

Agriculture, Trade, and Macroeconomics. Paper presented at the Conference on Agriculture in Rural Areas Approaching the 21st Century: Challenges for Agricultural Economics, Ames, IA, August 1986.

Overshooting of Agricultural Prices. Paper presented at the International Agricultural Trade Research Consortium, Lake Tahoe, CA, July 1986.

Political Failure and the Design of U.S. Agricultural Policy. Paper presented at the convocation honoring Vice President James B. Kendrick, Jr., University of California at Davis, June 1986.

Alternative Trade and Macroeconomic Scenarios: Implications for U.S. Agriculture. Paper presented at the Farm Policy/Technology Conference, University of California, Agricultural Issues Center, June 1986.

Private Sector Responses to Target Prices and Deficiency Payments. Paper presented to Resources for the Future, Washington, DC, May 1986.

A Coherent Policy for U.S. Agriculture. Major address at the Conference on Food Policy and Politics: A Perspective on Agriculture and Development. Purdue University, West Lafayette, Indiana, May 1986.

Macroeconomics, Overshooting, and the Design of Public Policy. Major invited address to the Midwest Economic Association, Chicago, Illinois, March 1986.

The Effects of Monetary Policy on U.S. Agriculture. Invited paper presented at the annual meeting of the Australian Agricultural economics Association, February 1986.

Macroeconomic Relationships. Paper presented to Cooperative Extension Economic Leaders, San Francisco, CA, January 1986.

Macroeconomic Linkages to Agriculture. Paper presented to the Department of Economics, Michigan State University, January 1986.

Some Political Aspects of Macroeconomic Linkages with Agriculture. Paper presented at the American Economic Association Annual Meeting, New York, December 1985.

Macroeconomic Linkages, Taxes and Subsidies on the U.S. Agricultural Sector. Paper presented at the American Economic Association Annual Meeting, New York, December 1985.

The Food Marketing System: Relevance of Economic Efficiency Measures. Major invited address at the Conference on Economic Efficiency and Agriculture and Food Marketing; sponsored by the University of Florida, Farm Foundation and the Agricultural Marketing Service, U.S. Department of Agriculture. Arlington, Virginia, October 1985.

Instability in Agricultural Markets: The U.S. Experience. Major invited address to the International Association of Agricultural Economists, Malaga, Spain, August 1985.

Multimarket Efficiency Analysis. Paper presented at the London School of Economics, August 1985.

Distributional Effects of Agricultural Policies. Paper presented at Oxford University, August 1985.

A Comprehensive Framework for Analysis of Future Markets. Paper presented to the Chicago Mercantile Exchange, June 1985.

The Design of U.S. Food and Agricultural Policy. Major invited address to the U.S. Congressional Conference, Urban-American Stake in the National Farm Crisis. Washington, DC, April 1985.

Overshooting in Commodity Future Markets. Paper presented at the Department of Economics, University of Wisconsin, Madison, April 1985.

Multiple Effects of Exchange Rates on Import Demand. Paper presented to the U.S. Department of Agriculture, Economic Research Service, Washington, DC, March 1985.

Macroeconomics and U.S. Agricultural Policy. Major invited address to the American Enterprise Institute for Public Policy Research. Washington, DC, January 1985.

A Synthesis of Major Evaluations of Alternative Proposals for the 1985 Food Security Act. Major invited address at the National Center for Food and Agricultural Policy and National Agricultural Forum Conference, Policy Choices, 1985. Washington, DC, December 1984.

Agricultural Trade and Unstable Exchange Rate Movements. Paper presented to the Brookings Institution, Washington, DC, November 1984.

Monetary Reaction Functions and the income Link for Agricultural Export Demand. Paper presented to Resources for the Future, Washington, DC, October 1984.

New Designs for Funding Public Research in Agriculture. Paper presented at the Department of Agricultural Economics, Ohio State University, September 1984.

Food Margin Relationships: Fix- Versus Flex-Price Determinations. Paper presented at the Department of Economics, Iowa State University, September 1984.

The Relative Effectiveness of Agricultural Sector Versus Macroeconomic Policies. Paper presented at the American Agricultural Economics Association Annual Meeting, Cornell University, August 1984.

Short Run Nonneutrality and Dynamic Overshooting Paths. Paper presented at the U.S. Department of Agriculture, Economic Research Service, Washington, DC, August 1984.

Uncertain Economic Environments and Conditional Policies. Paper presented at the Giannini Foundation/Resources for the Future conference on Alternative Agriculture and Food Policies and the 1985 Farm Bill, Berkeley, CA, June 1984.

Review and Assessment of Alternative Agricultural Policy Proposals. Paper presented at the Giannini Foundation/Resources for the Future conference on Alternative Agriculture and Food Policies and the 1985 Farm Bill, Berkeley, CA, June 1984.

The Major Issues in Agricultural Public Policy Management. Paper presented to the Graduate School of Management, Yale University, May 1984.

Hedging Strategies for Grain Importing Countries. Paper presented to the Chicago Board of Trade, Chicago, IL, March 1984.

Regulation in Commodity Futures Markets. Major invited address to the American Enterprise Institute. Washington, DC, January 1984.

The Role of Agricultural Price Supports and Land Controls in Technological Adoption Under Uncertainty. Paper presented to the Department of Agricultural and Applied Economics, University of Minnesota, January 1984.

Post-Bayesian Statistical Inference. Paper presented to the Department of Statistics, Iowa State University, November 1983.

Expectation Patterns, Cost of Information, and the Role of Future Markets. Paper presented to the Department of Economics, University of Chicago, September 1983.

Agricultural Output and the Effectiveness of Government Policy. Paper presented at the American Agricultural Economics Association Annual Meeting, Purdue University, August 1983.

Equity and Efficiency in Agricultural Production Systems. Major invited address to the Plenary Session of the International Association of Agricultural Economists. Jakarta, Indonesia, 1982.

Political Economic Markets: PERTs and PESTs in Food and Agriculture. Keynote address to the American Agricultural Economics Association Annual Meetings. Logan, Utah, 1982.

Modeling Agriculture for Policy Analysis in the 1980s. Major invited address at a special symposium sponsored by the Federal Reserve Bank of Kansas City. September 1981.

Agriculture, Food, and the Government. Invited address to the American Economics Association Annual Meeting. New York, 1981.

Prospects and Limitations of Operations Research in Agricultural Policy Investigations. Major invited address at the Plenary Session of the International Operations Research Conference. Jerusalem, Israel, 1979.

Natural Resource Economics and Policy. Keynote address to the Farm Foundation Research Workshop, Natural Resource Economics and Policy. University of Massachusetts, Amherst, 1976.

OTHER INVITED SEMINAR PRESENTATIONS

Agency for International Development (27)*; Agricultural Development Council (4); American Agricultural Economics Association (34); American Agricultural Law Association (1); American Economics Association (11); American Enterprise Institute (2); American Finance Association (5); American Sheep Industry (2); American Statistical Association (9); American Water Resource Association (3); Applied Econometric Association Conference (2); Argentina Universities (9); Australian Agricultural Economics Society (5); Australian National University (3); Brown University (1); California Agricultural Trade Seminars (1); California Women for Agriculture, Los Angeles (2); Chicago Board of Trade (6); Citizens for a Sound Economy Foundation (2); Columbia University (2); Commodity Futures Trading Division of Economic Analysis (1); Commonwealth Club (2); Conference on Agricultural Economic Policy Reform in Egypt (1); Conference of Economywide Effects of Developed Country Agricultural Trade Policies (1); Econometric Society (North American, European, World) (11); Economics Branch, Agriculture Canada (15); European Agricultural Economics Association (1); Farm Credit Council (2); The Ford Foundation (6); Harvard Institute of Development (2); Harvard University (12); Heritage Foundation, Washington, DC (2); Illinois Agricultural Leadership Foundation (1); Institute of Electronics and Electronics Engineers Decision and Control Conferences (2); International Association of Agricultural Economists (6); International Monetary Fund (4); Iowa State University (9); League of Women Voters (Berkeley and Washington, DC) (5); London School of Economics (3); Massachusetts Institute of Technology (4); Melbourne University (3); Michigan State University (2); Midwest Economic Association (2); Monash University (1); National Bureau of Economic Research (7); National Cotton Council of America (2); New York Pension Fund Association (2); North Carolina State University (6); Northern Illinois University

(3); Oklahoma State University (1); Operations Research Society (5); Organization of Professional Employees (3); Princeton University (2); Purdue University (6); Regional Research Strategy Committees (9); Rotary Club of Berkeley (1); Soviet-American Symposium (1); Stanford University (4); State University of New York (2); Texas A&M University (2); The Institute of Management Sciences (4); Town Hall of California, Los Angeles (1); Trade Policy Research Center, United Kingdom (3); University of Adelaide (1); University of California, Berkeley (28); University of California, Davis (9); University of California, Santa Barbara (2); University of California, Los Angeles (4); University of Chicago (9); University of Florida (2); University of Georgia (1); University of Heidelberg (1); University of Illinois (3); University of Maryland (1); University of Massachusetts, Amherst (2); University of Minnesota (5); University of Missouri (3); University of Nebraska (1); University of New England (3); University of North Carolina (1); University of Pennsylvania (3); University of Prague (1); University of Rhode Island (1); University of Salsberg (1); University of Saskatchewan (1); University of Sydney (2); University of Western Australia (2); U.S. Department of Agriculture (15); Washington, DC, Economists Club (3); Western Economics Association (7); World Affairs Council (2); World Perspective Seminar (1); The World Bank (10); Yale University (3); Institute for Policy Reform (12).

*Number of Presentations (Total: 428).

PUBLIC, UNIVERSITY AND PROFESSIONAL SERVICE

Member, U.S. Trade Representative (USTR/USDA) advisory committee on WTO negotiations, 2005–2007

Member, Finance Committee, Pacific Graduate School of Psychology, 2003–

Member, Committee to increase student enrollment, Department of Agricultural and Resource Economics, University of California, Berkeley, 2002–

Member, Board of Visitors, Center for Science, Policy, and Outcomes, 2000–

Member, Board of Trustees, Pacific Graduate School of Psychology, 1999–

National Development Council, California State University, Fresno, 1998–

Member, Board of Directors, Lawrence Hall of Science, 1998–

Joint Policy Council on Agriculture and Higher Education, Committee on Cooperation in Education, 1997–

Columbia University, Columbia Earth Institute (CEI) Advisory Board, October 1997–

Graduate Group in Energy and Resources, University of California, Berkeley, 1996–

Campus Advisory Board, Lawrence Hall of Science, University of California, Berkeley, 1996–

Executive Committee, International and Area Studies Executive Committee, University of California, Berkeley, 1994–

Associate Director, Agricultural Experiment Station, University of California, Berkeley, 1994–2000

Director, Institute for Natural Resource Systems, University of California, Berkeley, 1994–2000
Berkeley Division, Academic Senate, Committee on University Extension, 1992– 1994

Member, Economic Discipline Board, Fulbright Scholarship Awards, 1989– 1993

Numerous Departmental and College-Level Committees, 1970–

Member, Committee to revise ANR's mission statement, University of California, 2003

Chair, Finance Committee, Pacific Graduate School of Psychology, 2002–03

Chair, Division of Agriculture and Natural Resources Reorganization Committee, University of California, 2002

Chair of the Electorate Nominating Committee for the AAAS Section on Social, Economic and Political Sciences, 2001–2002

Chair, Review Committee for the Dean of the School of Journalism, University of California, Berkeley, 2001

Member, Northwest Precinct Space Study Committee, University of California, Berkeley, 2000

Member, Geographic Information Service Advisory Council, University of California, Berkeley, 2000

Member, Fundraising Workgroup Committee, University of California, Berkeley, 2000

Student Deans' Council, University of California, Berkeley, 1994–2000

Division Chairs Council, University of California, Berkeley, 1994–2000

Council of Deans, University of California, Berkeley, 1994–2000

Chancellor's Advisory Committee on Biology, University of California, Berkeley, 1994–2000

Ex officio member, College of Natural Resources Advisory Board, University of California, Berkeley, 1994–2000

Executive Committee of Environmental Council, University of California, Berkeley, 1994–2000

Council of Deans and Directors, University of California, Systemwide, 1994–2000

College of Natural Resources Advisory Board, University of California, Berkeley, 1994–2000

College of Natural Resources Development Committee, University of California, Berkeley, 1994–2000

Cooperator, "Higher Education Collaboration Between the United States and the European Community," the Fund for the Improvement of Postsecondary Education (FIPSE), 1993–2000

Geographic Information Science Center's Advisory Council, University of California, Berkeley, 1999

Course Material Fees Committee, University of California, Berkeley, 1999

Search Advisory Committee for Assistant Vice President, DANR, 1999

Search Committee, Vice Chancellor University Relations, 1999

Nominating Committee of the Social, Economic, and Political Science, American Association for the Advancement of Science (AAAS). January, 1999

Search Committee, Vice Chancellor Capital Projects, 1998

Chair, Advisory Committee, Kearney Foundation for Soil Science, Division of Agricultural and Natural Resources, University of California, Berkeley, 1995

Member, Board for International Development Studies, Fletcher School of Law and Diplomacy, Tufts University, 1992–95

University Extension Committee, Berkeley Division, Academic Senate, University of California, Berkeley, 1993–94

Agricultural and Food Marketing Consortium Planning Committee, 1993–94

Chair, Search Committee for Chair of Slavic Center, University of California, Berkeley, 1993–94

Member of Advisory Board, International Center for Self-Governance, 1991–1994

University of California Systemwide Energy Research Advisory Committee, 1988–94

Member Capital Campaign 2001, Knowledge for the Future, Subgroup: Environment, Resources, and Ecology, 1993

College of Natural Resources Committee to Form International Institute for Natural Resource Systems, University of California, Berkeley, 1991–92

College of Natural Resources Internal Reorganization Committee, University of California, Berkeley, 1990–1992

Editor, Agricultural Management and Economics, Springer-Verlag, 1988–92

Board of Directors, Universitywide Energy Research Center, 1988–1992

Evaluation of World Bank Research Proposals (14 evaluations), 1979–1992
 Chairman, Search Committee for Director of Soviet Studies, 1991
 Agricultural Academy of Science-Soviet Union Delegation, 1990
 Cofounder of the Institute for Policy Reform, Washington, DC, 1989
 Founder of the Agency for International Development Research Fellow Program, 1989
 Dean's Selection Committee for College of Natural Resources Technical Advisory Committee, 1989
 Chairman and Member, Berkeley Campuswide Committee to Evaluate the Department of Economics and Related Economic Programs, 1988–1989
 Advisory Committee, Environmental Protection Agency, Evaluation of Environmental Regulations on Agriculture, 1987–1989
 Resources for the Future, National Center for Food and Agricultural Policy Task Force on Multilateral Trade Negotiations, 1988
 U.S. Department of Agriculture, Task Force on Analytical Research Supporting the Trade Representatives Office, 1988
 Member, Advisory Committee, Government Accounting Office on U.S. Agricultural Export Strategies, 1987–88
 Departmental Faculty/Extension Coordination Committee, University of California, Berkeley, 1987–88
 Chairman, Political Economy of Natural Resources Panel, 1987–88
 U.S. Government Task Force on U.S. Agricultural Policy and Position in GATT Negotiations, 1987–88
 Member, Evaluation of EPA Regulation on U.S. Agricultural Sector Committee, 1987–88
 United States Negotiating Team for the OECD Communique on Agricultural Reform, May, 1987
 United States Senate Panel on “1985 Farm Bill Revisited: Competitive Views,” March, 1987
 Council for Foreign Relations Task Force on Trade Policy Options for the United States, 1987
 General Accounting Office Task Force on Alternative Public/Private Marketing Mechanisms for U.S. Food and Agriculture, 1987
 U.S. Government Task Force on the Farm Credit System, 1987
 Chairman and Member, School of Business Administration Planning Committee, University of California, Berkeley, 1986–87
 Organizational Committee for Farm Policy-Technology Conference, Agricultural Issues Center, University of California at Davis, 1986
 American Agricultural Economics Association Committee on Journal Publishing, 1986
 Member, Search and Selection Committee for Vice President of Agriculture and Natural Resources, University of California Systemwide, 1985–86
 Chairman, Strategic Review of Giannini Foundation, 1985–86
 Member, Agricultural Policy Planning Committee, American Agricultural Economics Association, 1984–1986
 Departmental Food and Agricultural Act Symposium Committee, University of California, Berkeley, 1984–1986
 The American Agricultural Economics Association Board of Directors, ex officio, 1984–1986
 Chairman, American Agricultural Economics Association, Outstanding Journal Article Committee, 1983–1986
 Editor, American Journal of Agricultural Economics, 1983–1986
 Member, Board of Directors, Giannini Foundation of Agricultural Economics, 1979–1986
 Chairman, Executive Committee, Giannini Foundation, 1979–1986

Member, Planning Committee for Agriculture and Food Policy Evaluation, Resources for the Future, 1984–85

Member, Advisory Committee for the Design of the Agricultural Issues Center, University of California Systemwide, 1984–85

Member and Director, Agriculture Study Group, Commonwealth Club, 1983–1985

Chairman, Departmental Endowment Committee, University of California, Berkeley, 1979–1984

Chairman, Western Agricultural Economics Research Council, 1982–83

Member, Planning Committee, Berkeley Food Cooperative, 1980–1983

Vice Chairman, Western Agricultural Economics Research Council, 1981–82

American Agricultural Economics Association Publication of Enduring Quality Award Committee, 1981–82

Western Nutrition Center Planning Committee, 1980–1982

Joint Land Grant University/U.S. Department of Agriculture Committee on New Research Directions, 1979–1982

Coordination Board, Giannini Foundation, 1979–1982

Associate Editor, Journal of Dynamics and Control, 1978–1982

Associate Book Review Editor, Journal of the American Statistical Association, 1974–1982

Western Nutrition Center Coordinating Committee, 1980–81

Secretary, Western Agricultural Economics Research Council, 1980–81

Arab-American Council for Cultural and Economic Exchange, Egyptian Agricultural Development Committee, 1979–80

Editorial Board, American Journal of Agricultural Economics, 1977–1980

Agricultural Econometric Modeling and Forecasting Symposium Participant, 1973–1980

Chairman, Joint University-Governmental Symposium on Agricultural Sector Forecasting and Policy Evaluations, Washington, DC, 1979

National Bureau of Economic Research Workshop Participant, 1974–1979

Chairman, Research Evaluation Committee for Desert Research Institute, Israel, 1978

Academic Representative to U.S.-U.S.S.R. Agreement on Cooperation in Agricultural Economic Research and Information, 1977

Member, World Bank Committee on Research Quality Control, 1976–1977

Harvard University Executive Education Program Instructor, 1975–1977

Agricultural Development Council Workshop Participant, 1974–1977

Associate Editor, Journal of the American Statistical Association, 1973–1977

Member, Outstanding Ph.D. Dissertation Committee, American Agricultural Economics Association, 1974–1976

Ford Foundation Visiting Professor, Argentina, 1972

College Union Board of Directors, 1966–1972

Interfraternity Council Board, 1965–1967

University of California, Berkeley, Ad Hoc Review Committee for Tenure Appointments (19 appointments, 9 as Chair).

EDITORIAL COLLABORATIONS

Review of Agricultural Economics, 1990–
Springer-Verlag, 1988–
Review of Economic Studies, 1987–
Economic Journal, 1986–
Journal of Futures Markets, 1986–

Review of Futures Markets, 1986–
Economic Development and Cultural Change, 1985–
Journal of Economic Theory, 1985–
Journal of Monetary Economics, 1984–
Journal of Development Economics, 1982–
Journal of Environmental Economics and Management, 1981–
Journal of Economic Dynamics and Control, 1978–
Resources and Energy, 1978–
Australian Journal of Agricultural Economics, 1977–
Decision Sciences, 1977–
IEEE Transactions on Automatic Control, 1977–
Journal of Economics and Business, 1977–
Management Science, 1977–
American Economic Review, 1976–
Quarterly Journal of Economics, 1976–
Journal of Finance, 1975–
Econometrica, 1974–
Review of Economics and Statistics, 1974–
Journal of Econometrics, 1973–
Journal of Political Economy, 1973–
Journal of the American Statistical Association, 1971–
American Journal of Agricultural Economics, 1970–
Annals of Economic and Social Measurement, 1974–1977

AD HOC REVIEWING

Agriculture Canada, 1991– , 1978–1982
 Club of Paris, various governmental consulting groups, 1988–
 U.S. Council of Economic Advisors, 1986–
 U.S. General Accounting Office, 1983–
 U.S. Congressional Budget Office, 1982–
 American Enterprise Institute, 1981–
 United States-Israeli Binational Agricultural Research and Development Fund (BARD), 1980–
 World Bank, 1979–
 National Science Foundation, 1976–
 Giannini Foundation Monograph Series, 1971–
 Intergovernmental Consulting Group on Indonesia, the Hague, 1989–1990

PH.D. DIRECTORSHIPS

Sixty-two Ph.D. theses in the areas of Natural Resource Damages; Agricultural Economics and Policy; Industrial Organization and Antitrust Analysis; Water Resources; Human Capital; Recreational Economics; Environmental Economics; Energy Policy; Public Policy; Managerial Economics; Adaptive Control; Econometrics; International Trade; Commodity Markets and Models; Governmental Food and Nutrition Policies; Operational Designs of Decision Support Systems; U.S. Livestock Feed Grain Sector; Agricultural Cycles; Futures Markets; Terms of Trade; Agricultural Land Prices and Agrarian Structure; Land Quality and Soil Conservation;

Agricultural Credit Markets; New Institutional Economics and Transaction Costs; Political Economy; Multilateral Negotiations; Design of Governance Structures; Industrial Organization of Food Industry; Transitional Economies; Risk Analytics; Health Economics, Political Power, Analytical Dimensions; Common Property Resources; Experimental Design; Statistical Methodologies.

RESEARCH GRANTS

Agency for International Development, U.S. State Department (numerous)
 Agriculture Cooperative Service, U.S. Department of Agriculture
 Agriculture Research Service, U.S. Department of Agriculture (numerous)
 Center for Agricultural and Rural Development (numerous)
 Chicago Board of Trade
 Chicago Mercantile Exchange
 Consortium of US Commodity Futures Exchanges
 Economic Research Service, U.S. Department of Agriculture (numerous)
 Economics Branch, Agriculture Canada (numerous)
 Ford Foundation (numerous)
 France-Berkeley Fund
 Giannini Foundation (numerous)
 Harvard University Research Institute
 International Monetary Fund
 National Center for Food and Agricultural Policy (numerous)
 National Science Foundation (numerous)
 OECD, France
 Resources for the Future
 State of Iowa Coal Project
 U.S. Department of Agriculture (numerous)
 U.S. Trade Representatives Office (numerous)
 U.S. Environmental Protection Agency (numerous)
 University of California Systemwide Biotechnology Research and Education Program
 University of California Water Resource Center
 Western Human Nutrition Center, U.S. Department of Agriculture
 World Bank

GOVERNMENT CONSULTING AND NONACADEMIC POSITIONS

Chairman, Board of Directors, OnPoint Analytics, 2004-
 Senior Consultant, CRA International, 2000-2006
 Board of Directors, Diversified Therapy Corporation, 1997-2005
 Chairman and Board of Directors, TriColor Line, Ltd., 1990-
 Board of Directors, Source for Automation, Inc., 1988-1996
 U.S. Department of Agriculture, 1975-
 Board of Directors, OnCure Technology (formerly US Cancer Care), 1998-2003
 Cofounder and Board of Directors, LECG, Inc., 1990-2000
 Board of Directors, U.S. Diagnostic Labs, 1994-99

Council of Economic Advisors, 1993–94, 1986–88
President and Board of Directors, Institute for Policy Reform, Washington, D.C., 1990–1994
Nathan Associates, Incorporated, Washington, DC, 1990–1991
Chief Economist, Agency for International Development, Washington, DC, 1988–1990
U.S. Department of State, 1986–1990
Ministry of Agriculture, England, 1987–88
World Bank, 1983–1988, 1975–76
Bureau of Agricultural Economics, Australia, 1986–87
Farm Credit Administration, 1986–87
U.S. Office of Management and Budget, 1986–87
Chicago Board of Trade, 1982–1986
Ministry of Agriculture, Spain, 1985
Chicago Mercantile Exchange, 1980–81
Oakridge National Laboratories, Energy Division, Oakridge, Tennessee, 1978–1981
Economics Branch, Agriculture Canada, 1977–1980
U.S. Bureau of Mines, 1974–1976
U.S. Office of Saline Water, 1973–1976
National Science Foundation Environmental Project, University of Chicago, 1973–1975
Manager, California Dairy and Truck Crop Farm, 1967–1973

INDUSTRY CONSULTING AND LITIGATION EXPERIENCE

Consulting experience in complex litigation, antitrust, regulated industries, measurement of economic damages, economic feasibility studies, market analysis, econometric modeling, environmental damages, development of portfolio investment models, and the assessment of risk management frameworks.